

WEB: www.yorkville.com

WORLD HEADQUARTERS
CANADA

Yorkville Sound
550 Granite Court
Pickering, Ontario
L1W-3Y8 CANADA

Voice: (905) 837-8481
Fax: (905) 837-8746

U.S.A.

Yorkville Sound Inc.
4625 Witmer Industrial Estate
Niagara Falls, New York
14305 USA

Voice: (716) 297-2920
Fax: (716) 297-3689

Yorkville

Quality and Innovation Since 1963

Printed in Canada

Yorkville

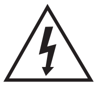
AP4040

PROFESSIONAL SERIES

MODEL TYPE: YS4040

SERVICE MANUAL

IMPORTANT SAFETY INSTRUCTIONS



This lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.

Ce symbole d'éclair avec tête de flèche dans un triangle équilatéral est prévu pour alerter l'utilisateur de la présence d'un « voltage dangereux » non-isolé à proximité de l'enceinte du produit qui pourrait être d'ampleur suffisante pour présenter un risque de choque électrique.



CAUTION ***AVIS***

RISK OF ELECTRIC SHOCK
DO NOT OPEN
RISQUE DE CHOC ELECTRIQUE
NE PAS OUVRIR



S2125A



The exclamation point within an equilatereal triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

Le point d'exclamation à l'intérieur d'un triangle équilatéral est prévu pour alerter l'utilisateur de la présence d'instructions importantes dans la littérature accompagnant l'appareil en ce qui concerne l'opération et la maintenance de cet appareil.

FOLLOW ALL INSTRUCTIONS

Instructions pertaining to a risk of fire, electric shock, or injury to a person

***CAUTION*: TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER (OR BACK).**

NO USER SERVICEABLE PARTS INSIDE.

REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

THIS DEVICE IS FOR INDOOR USE ONLY!

Read Instructions: The Owner's Manual should be read and understood before operation of your unit. Please, save these instructions for future reference and heed all warnings.

Clean only with dry cloth.

Packaging: Keep the box and packaging materials, in case the unit needs to be returned for service.

Warning: To reduce the risk or fire or electric shock, do not expose this apparatus to rain or moisture. *Do not use this apparatus near water!*

Warning: When using electric products, basic precautions should always be followed, including the following:

Power Sources

Your unit should be connected to a power source only of the voltage specified in the owners manual or as marked on the unit. This unit has a polarized plug. Do not use with an extension cord or receptacle unless the plug can be fully inserted. Precautions should be taken so that the grounding scheme on the unit is not defeated. An apparatus with CLASS I construction shall be connected to a Mains socket outlet with a protective earthing ground. Where the MAINS plug or an appliance coupler is used as the disconnect device, the disconnect device shall remain readily operable.

Hazards

Do not place this product on an unstable cart, stand, tripod, bracket or table. The product may fall, causing serious personal injury and serious damage to the product. Use only with cart, stand, tripod, bracket, or table recommended by the manufacturer or sold with the product. Follow the manufacturer's instructions when installing the product and use mounting accessories recommended by the manufacturer. Only use attachments/accessories specified by the manufacturer

Note: Prolonged use of headphones at a high volume may cause health damage on your ears.

The apparatus should not be exposed to dripping or splashing water; no objects filled with liquids should be placed on the apparatus.

Terminals marked with the "lightning bolt" are hazardous live; the external wiring connected to these terminals require installation by an instructed person or the use of ready made leads or cords.

Ensure that proper ventilation is provided around the appliance. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.

No naked flame sources, such as lighted candles, should be placed on the apparatus.

Power Cord

Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet. The AC supply cord should be routed so that it is unlikely that it will be damaged. Protect the power cord from being walked on or pinched particularly at plugs. If the AC supply cord is damaged DO NOT OPERATE THE UNIT. To completely disconnect this apparatus from the AC Mains, disconnect the power supply cord plug from the AC receptacle. The mains plug of the power supply cord shall remain readily operable.

Unplug this apparatus during lightning storms or when unused for long periods of time.

Service

The unit should be serviced only by qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

SUIVEZ TOUTES LES INSTRUCTIONS

Instructions relatives au risque de feu, choc électrique, ou blessures aux personnes

***AVIS:* AFIN DE REDUIRE LES RISQUE DE CHOC ELECTRIQUE, N'ENLEVEZ PAS LE COUVERT (OU LE PANNEAU ARRIERE)**

NE CONTIENT AUCUNE PIECE REPARABLE PAR L'UTILISATEUR.

CONSULTEZ UN TECHNICIEN QUALIFIE POUR L'ENTRETIENT

CE PRODUIT EST POUR L'USAGE À L'INTÉREUR SEULEMENT

Veuillez Lire le Manuel: Il contient des informations qui devraient êtres comprises avant l'opération de votre appareil. Conservez. Gardez S.V.P. ces instructions pour consultations ultérieures et observez tous les avertissements.

Nettoyez seulement avec le tissu sec.

Emballage: Conservez la boite au cas ou l'appareil devait être retourner pour réparation.

Avertissement: Pour réduire le risque de feu ou la décharge électrique, n'exposez pas cet appareil à la pluie ou à l'humidité. *N'utilisez pas cet appareil près de l'eau!*

Attention: Lors de l'utilisation de produits électrique, assurez-vous d'adhérer à des précautions de bases incluant celle qui suivent:

Alimentation

L'appareil ne doit être branché qu'à une source d'alimentation correspondant au voltage spécifié dans le manuel ou tel qu'indiqué sur l'appareil. Cet appareil est équipé d'une prise d'alimentation polarisée. Ne pas utiliser cet appareil avec un cordon de raccordement à moins qu'il soit possible d'insérer complètement les trois lames. Des précautions doivent êtres prises afin d'eviter que le système de mise à la terre de l'appareil ne soit désengagé. Un appareil construit selon les normes de CLASS I devrait être raccordé à une prise murale d'alimentation avec connexion intacte de mise à la masse. Lorsqu'une prise de branchement ou un coupleur d'appareils est utilisée comme dispositif de débranchement, ce dispositif de débranchement devra demeurer pleinement fonctionnel avec raccordement à la masse.

Risque

Ne pas placer cet appareil sur un chariot, un support, un trépied ou une table instables. L'appareil pourrait tomber et blesser quelqu'un ou subir des dommages importants. Utiliser seulement un chariot, un support, un trépied ou une table recommandés par le fabricant ou vendus avec le produit. Suivre les instructions du fabricant pour installer l'appareil et utiliser les accessoires recommandés par le fabricant. Utilisez seulement les attachements/accessoires indiqués par le fabricant

Note: L'utilisation prolongée des écouteurs à un volume élevé peut avoir des conséquences néfastes sur la santé sur vos oreilles. .

Il convient de ne pas placer sur l'appareil de sources de flammes nues, telles que des bougies allumées.

L'appeil ne doit pas être exposé à des égouttements d'eau ou des éclaboussures et qu'aucun objet rempli de liquide tel que des vases ne doit être placé sur l'appareil.

Assurez que lappareil est fourni de la propre ventilation. Ne procédez pas à l'installation près de source de chaleur tels que radiateurs, registre de chaleur, fours ou autres appareils (incluant les amplificateurs) qui produisent de la chaleur.

Les dispositifs marqués d'une symbole "d'éclair" sont des parties dangereuses au toucher et que les câblages extérieurs connectés à ces dispositifs de connection extérieure doivent être effectivés par un opérateur formé ou en utilisant des cordons déjà préparés.

Cordon d'Alimentation

Ne pas enlever le dispositif de sécurité sur la prise polarisée ou la prise avec tige de mise à la masse du cordon d'alimentation. Une prise polarisée dispose de deux lames dont une plus large que l'autre. Une prise avec tige de mise à la masse dispose de deux lames en plus d'une troisième tige qui connecte à la masse. La lame plus large ou la tige de mise à la masse est prévu pour votre sécurité. La prise murale est désuète si elle n'est pas conçue pour accepter ce type de prise avec dispositif de sécurité. Dans ce cas, contactez un électricien pour faire remplacer la prise murale. Évitez d'endommager le cordon d'alimentation. Protégez le cordon d'alimentation. Assurez-vous qu'on ne marche pas dessus et qu'on ne le pince pas en particulier aux prises. N'UTILISEZ PAS L'APPAREIL si le cordon d'alimentation est endommagé. Pour débrancher complètement cet appareil de l'alimentation CA principale, déconnectez le cordon d'alimentation de la prise d'alimentation murale. Le cordon d'alimentation du bloc d'alimentation de l'appareil doit demeurer pleinement fonctionnel.

Débranchez cet appareil durant les orages ou si inutilisé pendant de longues périodes.

Service

Consultez un technicien qualifié pour l'entretien de votre appareil. L'entretien est nécessaire quand l'appareil a été endommagé de quelque façon que se soit. Par exemple si le cordon d'alimentation ou la prise du cordon sont endommagés, si il y a eu du liquide qui a été renversé à l'intérieur ou des objets sont tombés dans l'appareil, si l'appareil a été exposé à la pluie ou à l'humidité, si il ne fonctionne pas normalement, ou a été échappé.

Yorkville AP4040 Power Amplifier

M1129 “THE INPUT BOARD”

The input board processes the audio signal from the input jacks to the volume control board, (M1128).

Each channel consists of a balanced gain stage, switchable subsonic filter, and a stereo / mono / bridge switch.

Looking at the left channel, the balanced input, (XLR Jack) and unbalanced input (phone jack) are wired in parallel to the input of a balanced operational amplifier, (U4). The gain of this stage is 0.82 (-1.3dB) balanced and 1.6 (4.0dB) unbalanced. Resistors R25, R27 along with capacitors C11 and C12 form a radio interference elimination filter.

Switch S1 selects the cutoff frequency of the hi-pass subsonic filter. The subsonic filter provides a 20Hz or 40 Hz high pass filter. The filter consists of a tee network on the input of U3 along with R10, R28, C29 and C30, C33 and C34. The gain is 1 (0dB) in the passband, (above 100Hz).

The audio signals from the input board M1129 pass through the 14 conductor cable to board M1128.

M1128 “VOLUME CONTROL BOARD”

This board contains:

- the front panel audio gain controls
- the front panel indicating LED’s (power, protect, activity and clip).
- the audio limiters

Circuit Explanation:

- The left channel of the circuit is explained.

(Refer to the schematic of M1128 as the sections of the circuit are explained.)

The audio signal out of M1129 passes through volume control P2 and the desired level enters U2 through pin 6. U2 is set for a gain of 5 (14dB) when the volume control is in the fully clockwise position.

The AP4040’s defeatable limiter is built around LD8. LD8 is an opto-resistive cell comprising of an LED that shines on a photocell. As the LED in the LD8 becomes brighter, the resistance of the photocell decreases, placing more of the audio signal on pin 5 (non-inverting input) of U2. This audio voltage gets subtracted from the signal on the inverting input and less signal appears on the output of U2. Transistors Q5 and Q6 along with the surrounding passive parts provide the attack and release time constants of the limiting function along with the drive currents for the clip LED and the LED inside LD8. When an audio signal on the output of the power amplifier section (on board M1146) enters clipping, pulses representing the duration of the clipped portion appear at LCLIP. These pulses turn on transistor Q6, and Q6 provides current pulses to turn on clip LED LD6. The pulses also pass through R7 and D6 to charge C3 and C36. When the voltage across C3 reaches 0.5 volts then Q5 turns on providing a current into the LED of the LD8 limiting the audio signal at U2. The charging (attack) and discharging (release) times of the limiter are 80mS and 3.5 seconds respectively. Resistors R50 and R7 provide the charging path, and resistor R51 provides the discharge path. The limiter can be defeated by placing the limiter switch (S2) in the in position which disconnects Q5 and the charging / discharging circuitry from V+.

The activity LED circuit consists of Q1 and the surrounding circuitry. The audio signal enters the activity LED circuit through R2. R2 and C21 form a differentiator that turns Q1 on illuminating the activity LED whenever the audio signal increases in amplitude. A constant current flows through R55A, R55B and when Q1 is off, the collector current then flows through D1.

From M1128 the audio signal passes through a 12-conductor ribbon cable to circuit board M1147.

On M1127 an operational amplifier U201 re-references the ground for the audio signal from LREF or RREF to the corresponding LOG (left output ground) or ROG (right output ground). U201 also provides DC correction for DC offsets appearing on the output binding posts. Feedback from the output binding posts appears on LFNB or RFNB. Through R203A or R203B the DC offset achieves a gain of -1 from U201. The DC offset of opposite polarity on the output of U201 will compensate for the DC offset in the amplifier section on M1146 resulting in 0 volts DC on the output binding posts.

- The audio signal continues to M1146 via an 8-conductor ribbon cable.

M1126 “THE VOLTAGE AMPLIFIER AND CURRENT AMPLIFIER”

This board contains:

- a voltage amplifier section
- a current amplifier section
- amplifier current limit section
- DC output protection
- heatsink temperature sensing

Voltage Amplifier Section

The voltage amplifier amplifies the audio signal’s voltage from 6.8 volts peak (at the output of U201) to approximately 98v peak, which is required to drive the current amplifier section. The current amplifier provides the current required for the 98v peak signal to drive 1200 watts into 4 ohms out of the binding posts.

Before the circuit is described in detail here is a quick rundown on the signal’s path through the voltage amplifier stage. Refer to the schematic of M1146. Let’s consider that a positive going AC signal is present at the SIG input. The positive going signal will turn on the positive side of the voltage amplifier. The signal at the SIG input turns on Q12A (through R40A, D14A and D13A). The collector of Q12A pulls down on the base of Q14A turns this transistor on further and allows a greater current to flow out of Q14A’s collector. This increase in current passes through Q15A and it’s collector to emitter voltage decreases. The collector of Q15A now being more positive in voltage turns the base of Q18A on causing an increase in Q18A’s collector current resulting in test point 1 going positive.

As the positive side of the amplifier was turning on the negative side would have been turning off. This is how test point 1 was able to move positive following the input signal. The reverse would hold true if a negative going signal were present on the input of the voltage amplifier.

CIRCUIT DESCRIPTION:

The voltage amplifier is a mirrored image with circuitry connected to the positive power supply rail being identical (but opposite polarity) to the circuitry connected to the negative power supply rail.

For this reason we will look in detail at the positive side of the amplifier.

The audio signal enters the voltage amplifier at the SIG input. The signal passes through R40A, D14A and D13A to the base of Q12A. Diodes D13A and D14A set up the DC bias on Q12A to approximately 0.6 mA.

The first voltage gain stage consists of Q12A along with the resistor chain on its collector and the emitter resistor (R44A).

Transistor Q12A drives the base of Q14A through the resistor chain. A DC current of approximately 4 mA should flow through the collector of Q14A. The voltage drop across Q14A remains constant and is derived from the voltage drop across the voltage reference Q20A, resistor R58A, and the base/emitter junction of Q15A. This total voltage should equal approximately 3 VDC. Transistor Q14A is the second gain stage and its output current flows through Q15A. Transistor Q15A is a common base stage with the collector driving the base of output buffer Q18A.

Diode D17A is a clamping diode that prevents the maximum peak of the audio signal from coming within 4V of the 144 VDC rail. This is to prevent the output current amplifier from going into saturation during clipping and therefore having storage delay problems.

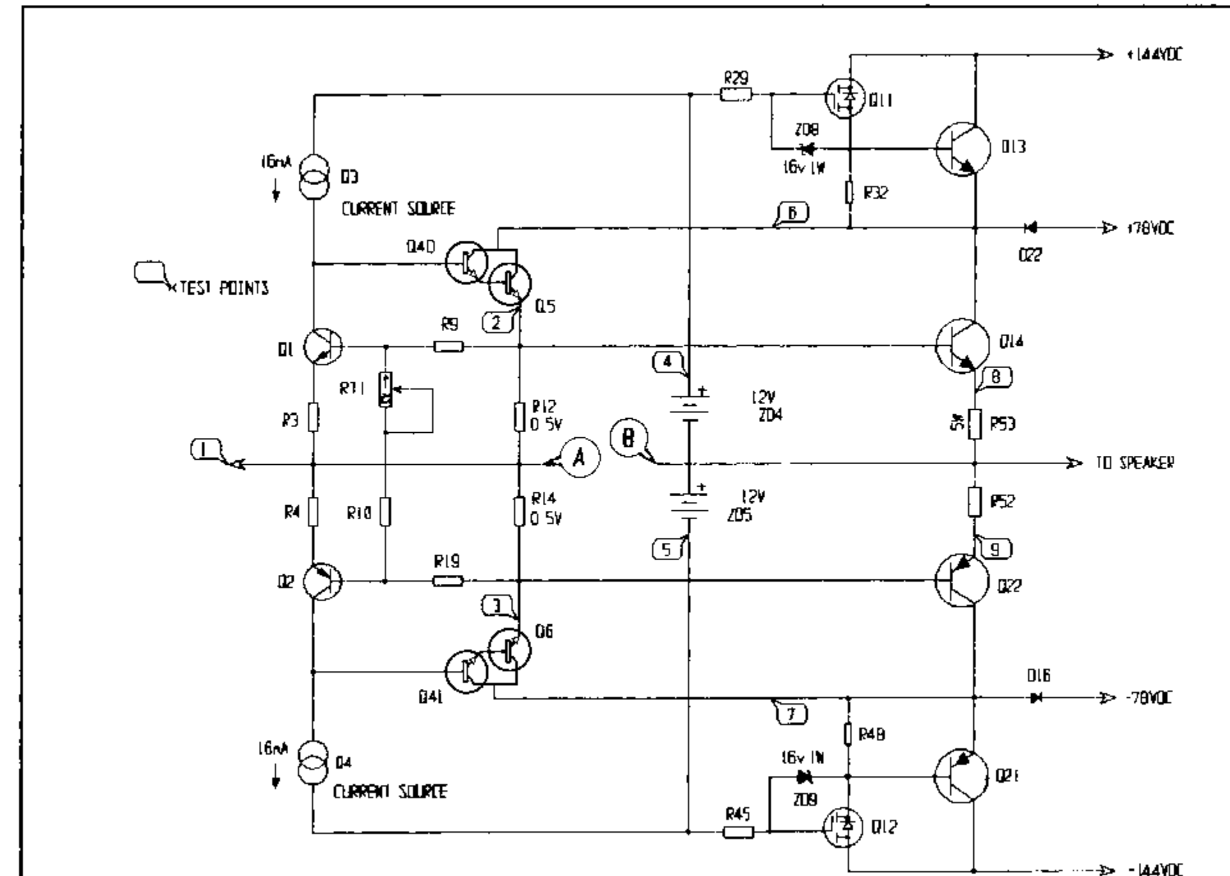
Transistor Q18A buffers the high impedance present on the collector of Q15A. The output of the buffer provides a low output impedance at the junction of R61A and R62A and is current limited to 30mA through the clamping action of D19A, D20A and D23A. The signal at the junction of R61A and R62A drives the succeeding current amplifier.

Current Amplifier Section

The current amplifier receives a high voltage audio signal from the voltage amplifier and provides the current drive necessary to drive speaker cabinets.

The current amplifier is a two-tier complimentary output driver design controlled by a complimentary darlington stage.

[CIRCUIT DESCRIPTION - REFER TO THE SIMPLIFIED SCHEMATIC #1 ON THE FOLLOWING PAGE]



Schematic 1

QUIESCENT CONDITION:

This design is class A/B and therefore the output driver transistors must be forward biased to provide low crossover distortion. In most class A/B designs, a diode chain or VBE multiplier is used to control the bias voltage and provide a means of adjusting the bias. This design is different, as there isn't a diode chain or VBE multiplier. For simplicity lets consider only the positive side of the current amplifier, that is all parts between the positive power supply rails and the audio signal output/input terminals. The negative side is the same as the positive, except for polarity changes.

To bias Q14, greater than 0.5V is needed from base to emitter, (or for simplicity from base to amplifier output). Points A and B are at the same potential, so consider them to be connected. If this is true then 0.5V from test point 2 to the amplifier output must appear across R12. There must be some way of developing this voltage across R12, and there is using the darington (Q5 and Q40) driver along with local feedback.

Simplified schematic #1 shows the biasing circuit. The current needed to develop 0.5V across R12 comes from the emitter of Q5. When the amplifier is first turned on the current source (Q3) turns on Q5 and Q40) and current flows through R12 developing a voltage. When this voltage approaches 0.5V Q1 turns on and robs current from the base of Q40.

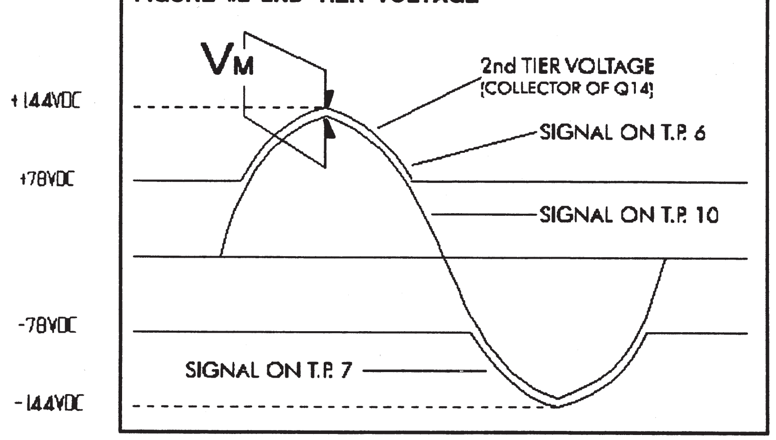
This causes Q40 to turn off until the reduced current flowing through Q5 maintains 0.5V across R12. Q1 will turn off slightly causing Q5 and Q40 to increase their collector currents. The circuit reaches a point of equilibrium with approximately 0.5V across R12.

Because all output devices are not identical and base emitter voltages vary, some adjustment must be available to slightly adjust the 0.5V across R12. This is accomplished with RT1. RT1 causes Q1 to turn on slightly more or less resulting in Q5 and Q40 turning on slightly more or less and therefore R12' s voltage will be slightly more or less than 0.5v. The proper quiescent current voltage is 4mV (to be measured between test points 8 and 9).

The Second Tier and Tier Switching

Refer to the simplified schematic Fig. #1 while reading the following text. One way of making an amplifier more efficient is to vary the Power Supply Voltage on the collectors of the output transistors (Q14 & Q22). The lower the voltage from collector to emitter, the lower the device dissipation. During quiescent conditions, there is 55VDC on the collectors of output transistors Q14 and Q22. The peak AC voltage that can appear on the amplifier's output is approximately 139V peak. How can an output transistor deliver a 139V peak when its collector is only at 78VDC? It can if its collector is pulled up to 144VDC as the output signal's peak rises above 78VDC. Refer to Fig. #2. The second tier voltage must remain above the amplifier's output voltage by amount Vm. Therefore the circuitry controlling the second tier voltage must increase the tier voltage before the amplifier's output voltage reaches 78VDC. This leading voltage is necessary to compensate for time lag of the second tier circuit during fast rising amplifier output signals.

FIGURE #2 2ND TIER VOLTAGE



The voltage between the amplifier's output and test point 4 is approximately 12VDC derived from the voltage drop across ZD4. We call this voltage the "floating battery" because it floats on top of the output audio signal with test point 4 always being 12VDC greater than the peak of the output signal. Test point 4 drives the gate of mos-fet Q11. Q11 controls the transistors of the upper tier. As Q11 turns on its source forward biases the base of Q13 and Q13 pulls the collector of Q14 towards the 100 volt rail. The gate to source voltage needed to turn on Q11 is approximately 3.5 volts. When the peak output signal is about 69.5vp (78v-(12v-3.5v)) then Q11 will start to turn on the second tier. The second tier voltage will remain about 13 volts (Vm) above the peak of the output signal to the point of clipping where this voltage is reduced to about 6 volts (measured driving an 8 ohm load). Zener ZD8 protects the gate source junction of Q11 and also provides a supply current path through R29 for the "floating battery".

NOTE: *The Power supply voltages given are those when the amplifier is* ***not*** *driving a speaker load. This will allow yo to check the tier switching with the cover of the amplifier off and the amplifier, therefore, running cool.*

Current Limit Protection Circuitry

To have an amplifier drive 3000 watts into practically any combination of speaker cabinets and know what is a safe load and what is not is a very difficult task. An extensive

amount of time was spent on the current limit circuitry so that it may simulate the safe operating area of the output transistors (SOAR curve). No matter how reactive the load may be the phase shift that it presents, along with it's resistive component is used to set the output current limit of the output transistor stage.

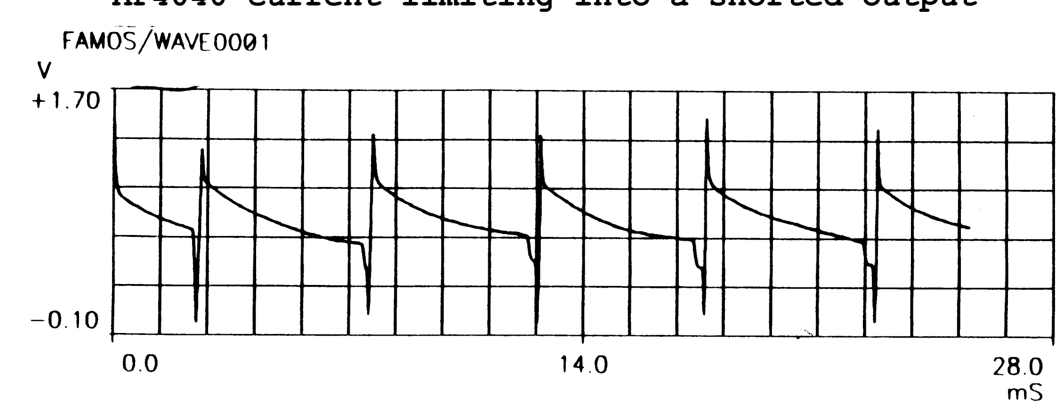
Refer to the schematic of board M1146 while reading the following text. The current limit circuitry is a mirrored image with circuitry connected to the positive power supply rail being identical (but opposite polarity) to the circuitry connected to the negative power supply rail. For this reason we will look at the positive side of the circuitry.

Transistor Q9 measures the peak current flowing through resistor R53. The voltage across R53 (as a result of the current flowing through it) is scaled down by R55, R35, R35A, R36, R37, D7 and D11 these parts make up the safe operating area along with the time constants of C30, R34, C12 and R26. Fig. #3 shows a waveform of the current that passes through R52 and R53 when the output of the amplifier is shorted to ground. This can only be seen by using an oscilloscope to measure differentially across R52 and R53. The conditions of the measurement are contained on the diagram. During current limit when Q9 turns on it reduces the voltage across R42. R42 is in series with a 16 volt zener (ZD7) and is also in parallel with the junction of Q8. The current that flows through R20, ZD7, R42, and R22 normally saturates Q8. When Q9 reduces the voltage across ZD9 and R42 to below 16.6 volts, Q8 turns off allowing a charge to build up on C8 through resistors R24 and R25. If current limiting occurs for a long enough duration to allow C8 to charge to 1.2 volts then Q7 will turn on tripping the relay circuit on board M1147. As soon as the relay is tripped the audio signal will be turned off at the output of the voltage amplifiers and will remain off for about 5 seconds before the relay turns on and allows the audio signal to pass through the amplifier. If a current limit condition is still present then the whole cycle will occur again and repeat until the load conditions on the amplifier's output are safe for the amplifier. When a safe load appears the amplifier will automatically reset and drive that load (the speaker cabinet).

DC Protection

If a DC voltage greater than 8 volts appears on the output of the amplifier for more than 200 milliseconds then triac Q30 will turn on holding the output at ground potential. MBS4992 is a device that turns on at either + or - 8 volts DC.

FIGURE #3 AP4040 current limiting into a shorted output



Measured between test points 8 and 9 on board M1146

FREQUENCY: 100Hz Y SCALE: 1 VOLT = 10 AMPS

NOTE: Every time you replace blown output transistors on a M1146 board test the DC protection triac with the following circuit.

Conditions of test:

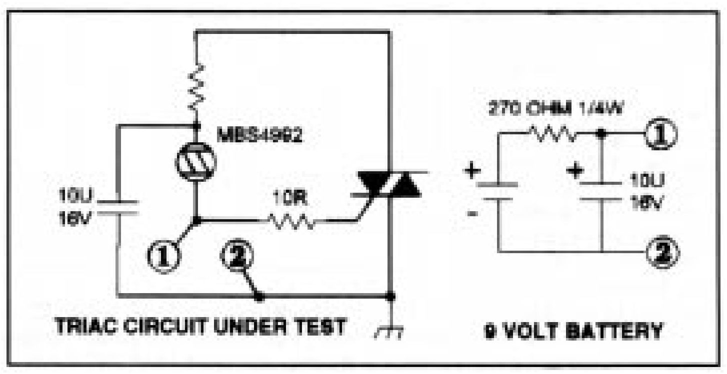
A) Pass a 100Hz 25v peak signal through the M1126 board under test with no load connected to the amplifier output.

B) Connect points 1 and 2 as shown in the diagram. The amplifier should go into protect mode as the triac (if working) shorted the output of the amplifier to ground, and the amplifier goes into current limit.

C) Disconnect the triac test circuit and allow the amplifier to complete it's protect cycle.

D) Reverse connections 1 to 2 and 2 to 1 and test again. The same results as in B) should be observed if the triac is working.

Only test the triac for one protect cycle as prolonged testing will heat the triac to a high temperature.



M1147 SHUTDOWN CIRCUIT, FAN CONTROL CIRCUIT, and SOFT TURN ON CIRCUIT:

- The shutdown relay and its associated drive circuitry have two possible operating states.
- Amplifier on under normal operating conditions.
- Amplifier power switch has just been turned OFF/ON, or the amplifier is in current limit protecting the amplifier's output transistors, or the amplifier has overheated.

Shutdown Circuit

Here is how the circuit accomplishes these functions. The relay's normally closed contacts short the output of the voltage amplifiers to ground when the power switch is off. When the power switch is turned on, the relay remains off (normally closed) for about 6 seconds. C203 charges to 35V and results in Q203 turning off allowing Q201 to turn on. As Q201 turns on, it connects the negative terminal of the relay's coil (Pin 16) to ground energizing the relay and opening the normally closed contacts.

If prolonged current limiting occurs on the amplifier's output transistors then D204 or D205 (depending on which channel is current limiting) will be forward biased turning on Q202 (from its off state). Now +144VDC appears on the collector of Q202 and through R210 and R211 turn on Q203 therefore turning off Q201 by shorting its base emitter junction. Q201 turning off will turn the relay off and the normally closed contacts (off state) will short the outputs of the voltage amplifiers to ground so as not to continuously stress the amplifier's output transistors. A cycle now occurs. With the voltage amplifiers now disabled there is no signal driving the output transistors (Q13 to Q28).

The current limit circuit protecting the output transistors (Q13 to Q28) turns off and D204 and/or D205 are not forward biased and Q202 turns off. Through Q203 and Q201 the relay is turned back on and the voltage amplifiers are now active again, driving the output transistors. If current limiting still occurs, then the same cycle will occur. If the cause of current limiting (low impedance or short on the speaker output terminals) has been removed, then the amplifier will continue to operate normally.

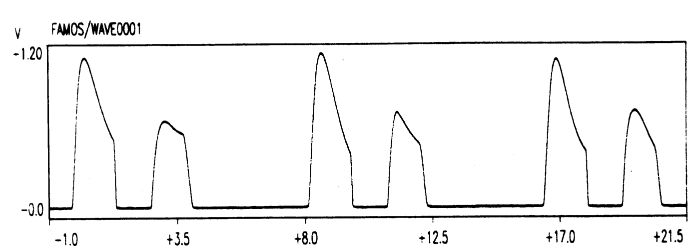
The third operation that the relay provides is "overheat shutdown". If for some reason the fan cannot keep the heatsinks in a safe operating temperature area then the fan control circuit (on board M1147) will deliver through D207 a positive current to turn Q203 on and turn Q201 off to turn off the relay and disable the voltage amplifiers. When the fan has cooled down the temperature of the amplifier, then the signal through D207 will disappear and the relay circuit will turn on the relay to resume normal operation. Anytime the relay is in the "protect" mode (due to the abnormal states) then contact pin 4 of the relay will illuminate LD3 (the protect LED on the front panel).

Soft Turn On Circuit

To reduce the "inrush" current that flows through the line cord from the 120 VAC power source (typical with large linear power supplies), a circuit provides a soft turn on function. When the power switch is turned on, the current that initially flows through the primary of the transformer must flow through SG201 and SG202. These are surgestors that reduce the peak inrush current flow. After about 500 milliseconds a relay's contacts short across the surgestors so that they are not stressed by the current flowing through them under normal operation. A circuit consisting of Q240, Q241, C215, and the associated resistors provides the time delay for the turn on cycle of the relay. The circuit is very similar to the shutdown time delay circuit. Refer to the section on the shutdown circuit for a circuit description.

FIGURE #4

AP4040 Fan Current waveform



measured voltage across R230, with 12VDC across the fan

Fan Circuit

Looking at the schematic to board M1147, here is a quick explanation of the fan control circuit. There is a temperature sensor (AS35) on each M1146 board. When the amplifier is first turned on, Q207 and Q208 are off. The AS35 temperature sensors are configured as temperature controlled current sources. As either temperature sensor begins to heat up, more current flows through D212 or D218 increasing the voltage drop across R235 or R236. The hotter temperature sensor will provide more current than the cooler sensor and therefore develop a higher voltage across it's associated 8K2 resistor. The higher voltage will forward bias D212 or D218 reverse biasing the cooler temperature sensor's diode so that the hotter sensor will control the fan speed. At 40 degrees C there

is 10 volts across R235 or R236 which is enough to turn on Q210, Q208, and Q207 providing 7 DC volts to the fan. Further heating the temperature sensors results in a larger DC voltage across the fan. To lower the dissipation of Q207, D215, D216, ZD205, ZD206 and R226 turn off Q207 and Q208 when the full wave rectified voltage present of the collector of Q207 reaches approximately 58V by robbing current from the base of Q208. The maximum fan voltage is 20.5 VDC. ZD207 and R228, R229 and R230 provide a current limiting function. Figure #4 shows the current through these resistors when there is 12VDC across the fan.

Thermal Shutdown Circuit

The emitter of Q210 in the fan circuit is the measuring point for the shutdown voltage. As the temperature sensing devices (AS35) that control the fan circuit heat up the voltage on the emitter of Q210 rises until at 85 degrees Celsius on the M1146 heatsinks. The voltage on the emitter of Q210 reaches 18 (85 degrees C) VDC and the amplifier must be shutdown to protect the output power transistors. ZD202 and D207 become forward biased and Q203 turns on turning the relay off and muting the audio signal. After the amplifier cools down the voltage will decrease until Q37 turns off turning the relay back on enabling the amplifier.

Identifying Defective Boards in the AP4040

STEP 1: VISUAL INSPECTION OF FRONT PANEL AND FAN

- Check to see whether the green power LED is lit. If not, the amplifier has a power supply (M1147 board), transformer, A.C. switch or line cord problem.
- If the red protect LED stays on or samples off and on, this usually indicates a problem with the voltage amplifier or current amplifier sections on one or both of the M1126 boards. Check for misaligned pin connections or see if the ribbon cables have been cut or pinched through their insulation.
- If the fan is running at full speed at power up this usually indicates a problem with the fan circuitry on the M1147 board, but it can also be caused by M1146 circuit problems. A damaged AS35 temperature sensor located under the M1146 heatsinks can cause erratic fan behavior.
- No output on either or both channels could be caused by intermittent push switches on the input board.

STEP 2: VISUAL INSPECTION OF INTERNAL CHASSIS AND INITIAL TESTING

After removing the lid, look for any signs of smoke, charring or burnt components. Before powering up replace the burnt components, and check the associated circuitry for damaged parts. Disconnect one M1127 board and test one board at a time to reduce the possibility of further damage. Use a variac to slowly increase the 120 VAC up from 0 volts while monitoring the quiescent current with a meter and the speaker output with an oscilloscope. Watch the speaker output for large DC offsets, or oscillation. Watch the meter for large collector currents flowing. Remember under quiescent conditions, there should only be 3 to 5 millivolts across test points 8 and 9 on the output stage of the amplifier.

SPECIFICATIONS

Frequency Response:	+/- 1dB, 20 Hz to 20 KHz
Hum and Noise:	-103 dB below max output RMS voltage, unweighted
THD (1 khz, 4–Ohms):	<0.01%
THD(20Hz – 20kHz, 4–Ohms):	<0.1%
High Pass Filter:	40Hz, 12 dB/octave
Slew Rate:	Power amp section: 25 V/uS, 50 V/uS in bridged mode
Damping Factor:	> 600, 20 Hz - 20 KHz, into 8 ohms
Crosstalk:	-75 dB below full output at 1khz, -60 dB below full output (20 Hz - 20 KHz)
Input Impedance:	20 KOhms balanced, 10 KOhms unbalanced
Input Sensitivity:	1.4 VRMS sine wave (**AP4020**: 36 dB, **AP4040**: 39 dB gain)
Rejection:	CMRR@60Hz: minimum 48dB, typical 56dB
Controls:	Rotary GAIN controls, MONO/STEREO/BRIDGE, FILTER and LIMITER switches
Displays:	2x CLIP, 2x ACTIVITY, PROTECT, POWER ON (LEDS)
Input Connectors:	2x XLR, 2x 1/4” phone (TRS)
Output Connectors:	2x Binding Post, 3x Speakon™ SP-4
Turn On/Off transients:	< 15 milliwatt / seconds, 0.5 Wpk. (1s on delay)
Power Consumption:	Typ 1130, Max 1800 Watts
Transformer:	Toroidal
Protection:	Fully protected: DC, LOAD and THERMAL
Cooling:	Aluminum Heatsinks with DC servo–controlled fan (in front, out rear)
Size:	(DWH) 44 cm x 48 cm x 9 cm (front panel to binding posts) (DWH) 17.5 in x 19 in x 3.5 in Two rack spaces
Weight:	43.5 pounds, 19.8 Kilograms

Quick Fix for M1146 & M1126

To speed up the servicing of the AP4020 or AP4040 on your bench, Yorkville Sound's service department has developed a method to replace the components most likely to fail when a M1146 amplifier board requires service.

This Quick Fix kit contains the procedure, assembly drawings, and components to perform the Quick Fix to a M1146 or M1126 board.

It should be understood that the person using this procedure knows how to test resistors, diodes, and transistors to determine if they are defective. This procedure is not intended to be a substitute for one's lack of electronic capability.

Before starting, look at the board for repair and locate the version number. It is very important that you follow the procedure for the appropriate circuit board version number.

A complimentary service manual for the AP4020 power amplifier is supplied with this M1146KIT.

STEP 1. Locate the assembly drawing for the version number printed on the M1146 or M1126 circuit board to be serviced.

STEP 2. Remove all of the transistors coloured RED on the assembly drawing.

STEP 3. Measure and remove any of the diodes coloured BLUE on the assembly drawing that may be damaged. Replace a 1N4732A 1W 4V7 zener (#6459) ZD12 along with a series 0.5 ohm R85 resistor.

STEP 4. Rotate the trim pot RT1 fully counter - clockwise as in figure 1. Inspect and replace any resistors that look burnt. Measure all of the resistor values coloured YELLOW on the assembly drawing. The value that you measure may not be exactly what is shown on the assembly drawing but if the resistor doesn't look damaged it should measure within + or – 5% of the printed value.

Canada
Voice: (905) 837-8481
Fax: (905) 837-8746

U.S.A.
Voice: (716) 297-2920
Fax: (716) 297-3689

www.yorkville.com

Yorkville Sound
550 Granite Court
Pickering, Ontario
L1W-3Y8 CANADA

Yorkville Sound Inc.
4625 Witmer Industrial Estate
Niagara Falls, New York
14305 USA

SERVICE BULLETIN

AP4020 & AP4040

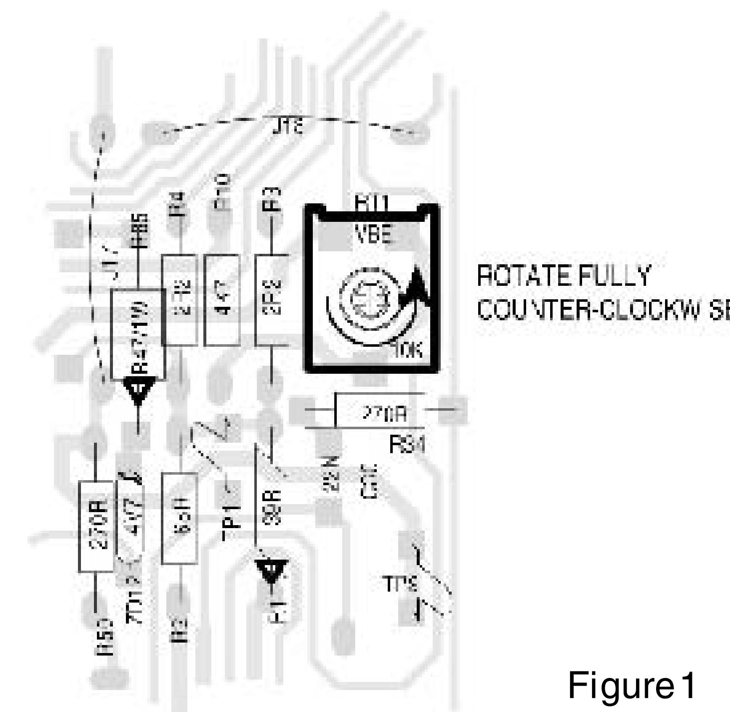


Figure 1

STEP 5. Measure the resistor coloured GREEN. The measured value should measure within + or – 5% value listed in the table below. Replace any resistor that measured beyond the + or – 5% value listed in the table below.

RESISTOR NUMBER	PRINTED VALUE	CORRECT *MEASURED* VALUE
R10	4K7	**-5%** **+5%** 3K08 3K25 3K41

Canada
Voice: (905) 837-8481
Fax: (905) 837-8746

U.S.A.
Voice: (716) 297-2920
Fax: (716) 297-3689

www.yorkville.com

Yorkville Sound
550 Granite Court
Pickering, Ontario
L1W-3Y8 CANADA

Yorkville Sound Inc.
4625 Witmer Industrial Estate
Niagara Falls, New York
14305 USA

1

STEP 6. Measure across the pair of test points shown in the component layout listed in the table below. If the measured value is not within + or – 10% of the value listed in the table then replace the resistors shown in the table below.

TEST POINTS	LAYOUT REFERENCE	CORRECT *MEASURED* VALUE	LAYOUT REFERENCE
R10	4K7	**-10%** **+10%** 15ohm 17ohm 19ohm	R11, R12, R14

STEP 7. Measure the resistors coloured ORANGE. Since the value of these resistors is 0.1 ohm, your ohmmeter will measure the higher series resistance of the test leads if the resistor is OK. If the resistor is damaged your ohmmeter will read a very high resistance (an open circuit). Replace any damaged resistors.

STEP 8. Measure the output TO–3 transistors (Q13 to Q28) to determine if any are damaged. Mark any damaged transistors with a marking pen.

STEP 9. Replace any output transistors that you have marked as being damaged. Replace any diodes that you have found to be damaged. Replace all of the red transistors that were removed.

STEP 10. Inspect the traces on the circuit board for any that have 'fused' open or looklike they got very hot. Bridge and solder a piece of wire over any damaged traces.

AFTER YOU HAVE REPLACED ALL OF THE NECESSARY COMPONENTS INSPECT THE REPAIRED BOARD FOR ANY MISSING PARTS, CORRECT VALUES IN THE CORRECT POSITION AND THAT ALL COMPONENTS ARE SOLDERED.

Canada
Voice: (905) 837-8481
Fax: (905) 837-8746

U.S.A.
Voice: (716) 297-2920
Fax: (716) 297-3689

www.yorkville.com

Yorkville Sound
550 Granite Court
Pickering, Ontario
L1W-3Y8 CANADA

Yorkville Sound Inc.
4625 Witmer Industrial Estate
Niagara Falls, New York
14305 USA

SERVICE BULLETIN

AP4020 & AP4040

Testing Repaired Circuit Boards

Now that you have rebuilt the M1146 or M1126 circuit board. It is just as important to properly power up the board. If the sinewave doesn't look right check the signal at test point (1) to ensure that the voltage amplifier isn't distorting the signal. If there is still a damaged part on the board instantly turning it on could blow up the board and you would be back where you started.

Connect the power wires and ground to the power supply. Connect a digital multimeter to test pins 8 and 9 to measure the bias quiescent current and place a scope probe on the speaker output. Be sure to turn the quiescent current trimpot RT1 fully counter clockwise.

Now using a variac slowly turn up the AC main voltage while monitoring the quiescent voltage and the speaker output trace on the scope. Watching these two test points is a good indicator of the health of the board. If you have a second multimeter connect it up from the speaker output to test point 4 or 5. As you variac up also check these DC battery voltages to ensure that they both increase in voltage to approximately +12 or –12 vdc.

If the board looks OK after variacing up to 120vac then slowly turn up the bias (RT1 trimpot) to obtain 3 to 5 millivolts of bias voltage on test points 8 and 9. Check the speaker output with a 1KHZ sinewave with no load. If this looks good place the minimum rated load (4 Ohm for M1126, 2 Ohm for M1146) on the speaker output and increase the sinewave amplitude to the point of clipping. If the signal looks free of oscillation, place a short across the speaker posts. The amplifier should go into protect mode after 1/10 of a second. Remove the short and the sinewave will appear 6 seconds later.

Reassemble the complete amplifier and run just clipping music or pink noise into the minimum rated speaker load for that model of amplifier. Let the amplifier heat up for 20 minutes. This will check the thermal mounting of the transistors and for any weak parts not caught during troubleshooting.

If the amplifier passes this test the product is ready to return to the customer.

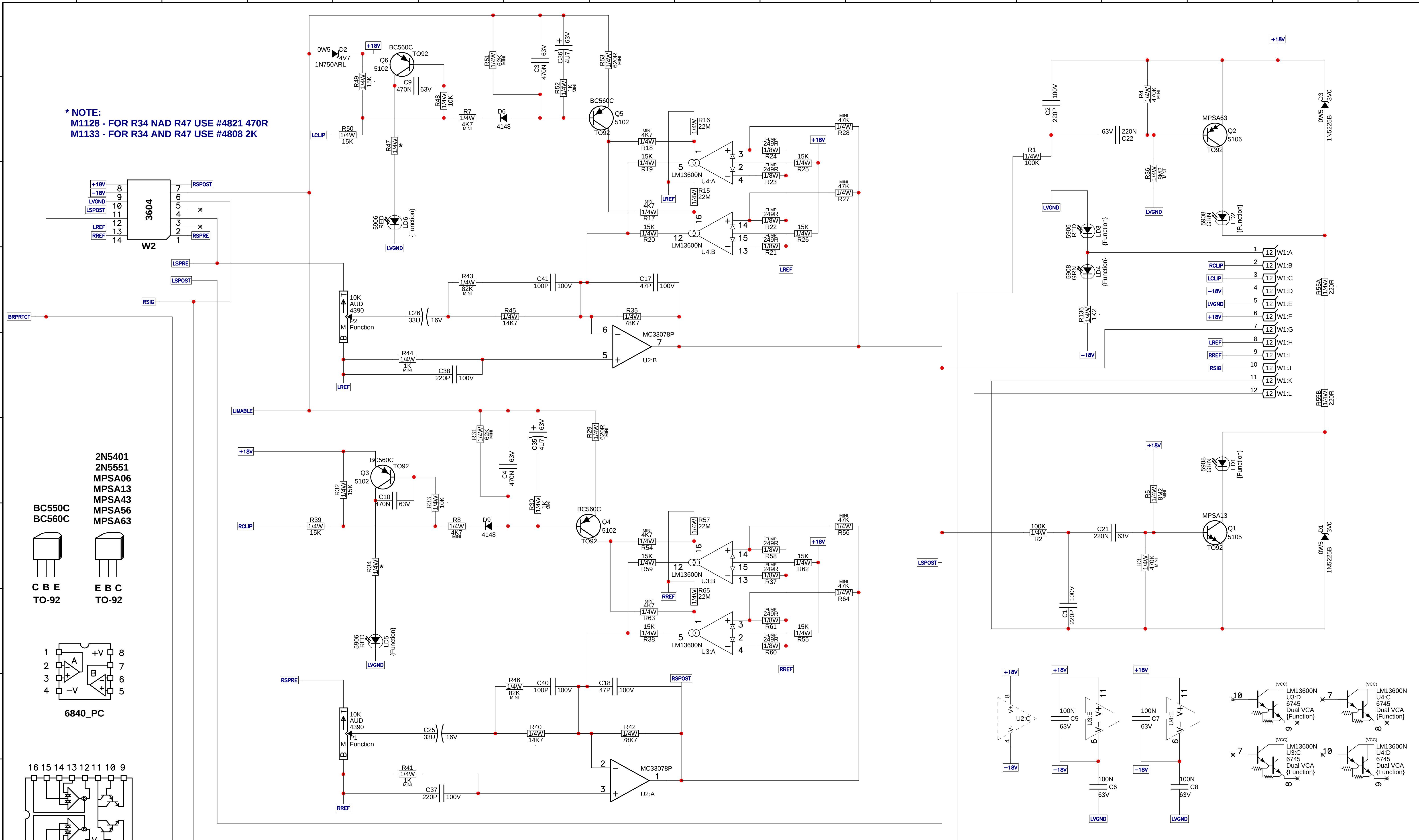
Canada
Voice: (905) 837-8481
Fax: (905) 837-8746

U.S.A.
Voice: (716) 297-2920
Fax: (716) 297-3689

www.yorkville.com

Yorkville Sound
550 Granite Court
Pickering, Ontario
L1W-3Y8 CANADA

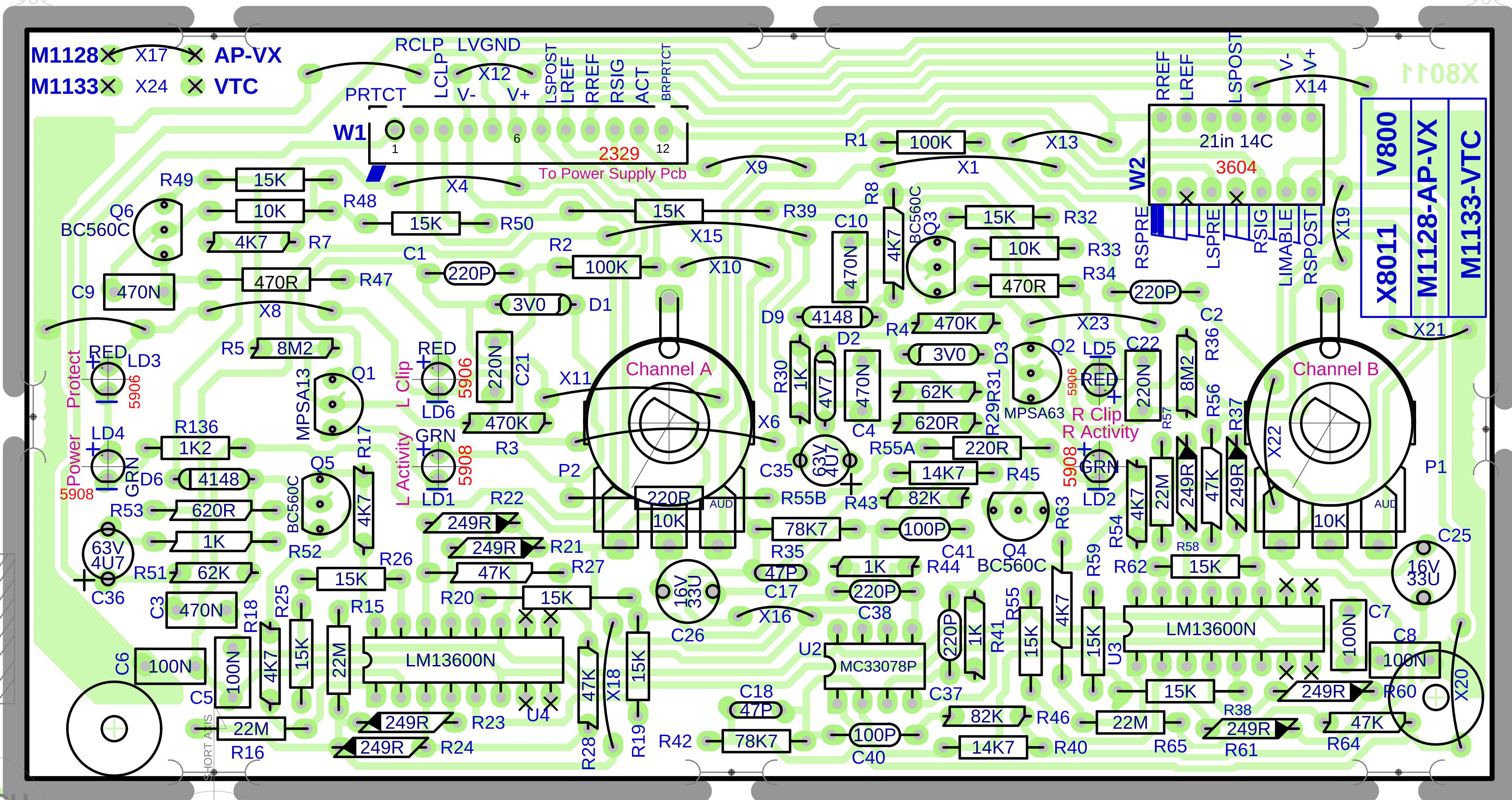
Yorkville Sound Inc.
4625 Witmer Industrial Estate
Niagara Falls, New York
14305 USA



Product **AP-VX-VTC POT PCB**

POT PCB	PCB# X8011	Sheet 1 of 1
Date: Fri May 29, 2009	Rev:8V00	
Filename: X8011V800sch.sch2002		

M1128 AP-VX



BlankSize - 14000x11000

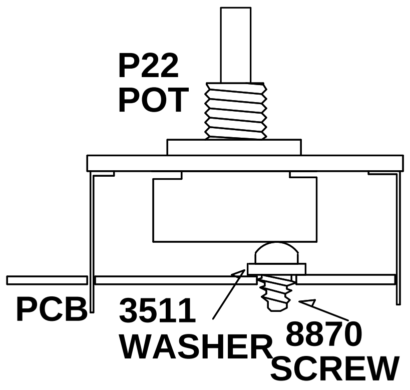
StepAndRepeat - X2@6.875Y3@3.300

SEE LAYOUT DOCUMENTATION

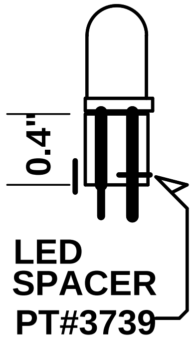
SEE LAYOUT DIAGRAM

X8011 PRODUCTION NOTES - M1128 AP/VX

1.



2.



SEE LAYOUT DIAGRAM

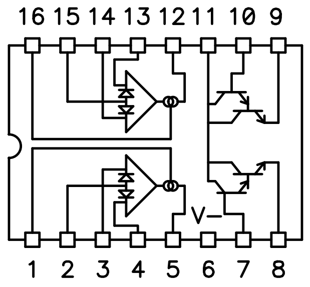
X8011 PCB_DATABASE_HISTORY			
MODEL(S):-	AP4020 AND AP4040/VX2400 AND VX2402/V42 AND V44		
#	DATE	VER#	DESCRIPTION OF CHANGE
1	OCT/97	1.00	FIRST PRODUCTION
2	APR/17/98	2.00	#5664 RIBBON CABLE CONNECTIONS CHANGED FOR
3	.	.	PROTECT CIRCUIT
4	DEC/09/98	3.00	PC#5736 TRACES CHANGED POT SUPPORT SCREWS
5	.	.	ADDED
6	NOV/20/01	3.10	PC#6466 LD7,LD8 NSL28AA->NSL32SR2
7	JUL/09/02	4.00	PC#6401 PARTS MOVED NEAR P2
8	OCT/25/02	4.10	PC#6568 R44/R41 10K->1K
9	APR/15/05	5.00	PC#6873 REDO SOLDERMASK
10	JUN/05/06	6.00	PC#7138:GT:CONVERT TO PCAD2002. CHANGE OPTO
11	.	.	LIMITER TO 13600 #6745 LIMITERS FOR ROHS
12	.	.	REPLACE C3,C4,C9 AND C10 WITH #5234 470N 63V
13	.	.	REPLACE R31 AND R51 WITH #6139 62K 1/4W
1	.	.	REPLACE R4 WITH #6127 470K 1/4W
2	JUN/23/08	7.00	Removed shear, solder update, std board size
3	28-MAY-2009	8.00	CREATE X8011, M1128 FOR AP, VX AND M1133 FOR VTC
4	.	.	PC#7717, 7718 - M1133,V42 AND V44 CHANGE R34
5	.	.	AND R47 FROM 470R TO 2K #4808
6	D	V	N
7	D	V	N
8	D	V	N
9	D	V	N
10	D	V	N
11	D	V	N
12	D	V	N
13	D	V	N

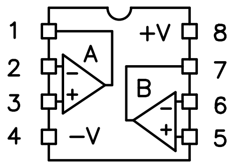
X8011 DRILL HISTORY			
MODEL(S):-	AP4020 AND AP4040/VX2400 AND VX2402/V42 AND V44		
#	DATE	VER#	DESCRIPTION OF CHANGE
1	D	V	N
2	D	V	N
3	D	V	N
4	D	V	N
5	D	V	N
6	D	V	N

X8011 PENDING CHANGES		
MODEL(S):-	AP4020 AND AP4040/VX2400 AND VX2402/V42 AND V44	
#	PC#	PENDING CHANGE
1	PC	X
2	PC	X
3	PC	X
4	PC	X
5	PC	X
6	PC	X

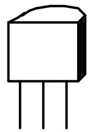
*PLACE IMPLEMENTED CHANGES INTO BOARD HISTORY

LEAD/PIN REFERENCE



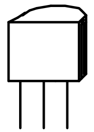


BC550C
BC560C

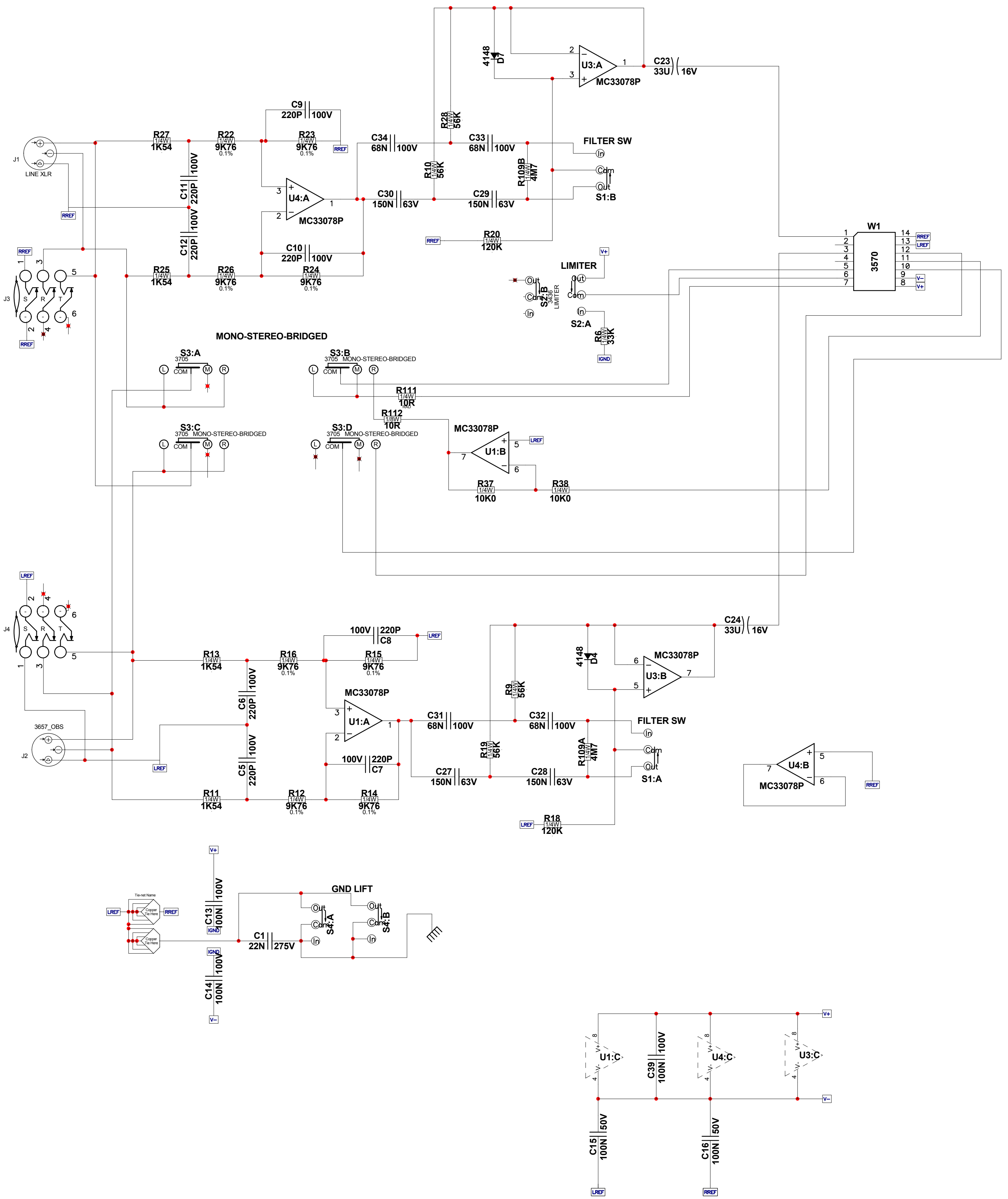


C B E
TO-92

2N5401
2N5551
MPSA06
MPSA13
MPSA43
MPSA56
MPSA63



E B C
TO-92



M1129 Database History			
MODEL(S):-	AP2020 AP4020 AP4040 AM1CE		
#	DATE	VER#	DESCRIPTION OF CHANGE
1	OCT/97	1.00	FIRST PRODUCTION
2	NOV/97	2.00	SWITCH NETS RREF WITH LREF AND RSPRE WITH
3	.	.	LSPRE AT 14 PIN CONNECTOR. INPUT TO NONINVERTING
4	DEC/02/97	.	CHANGE C27, C29, C28, C30 TO 150N
5	APR/16/98	3.00	PC#5694 PINS 10-12 OF MC2 CONNECTED TO BRG SWT
6	JUL/01/98	4.00	ISOLATE PIN OF S3
7	SEP/06/01	4.10	PC#6436 REPLACE R119 (10K0) WITH JUMPER X119
8	APR/15/05	5.00	PC#6873 REDO SOLDERMASK
9	JUL/2005	6.00	CONVERT TO PCAD2002, PC#6944:ROUTE GAUGE,
10	AUG-15-2005	.	PC#6914:ADD TARGETS
11	D	V	N
12	D	V	N
13	D	V	N

M1129.sch_schematic-DATABASE_HISTORY			
MODEL(S):-	AP4020 / AP4040 / AP2020 / AM1CE		
#	DATE	VER#	DESCRIPTION OF CHANGE
1	OCT/1997	1.00	FIRST PRODUCTION
2	NOV/12/97	2.00	REVERSED INPUT POLARITY. MODIFIED FOR AP2020
3	DEC/02/97	.	C27, C28, C29, C30 TO 150n
4	APR/22/98	2.10	PC#5694 ADD NETS BRPRTCT, LVGND-28 TO BRG SW
5	SEP/06/01	2.20	DELETE R119
6	JUL/2005	3.00	CONVERT TO PCAD2002
7	D	V	N
8	D	V	N
9	D	V	N
10	D	V	N
11	D	V	N
12	D	V	N
13	D	V	N

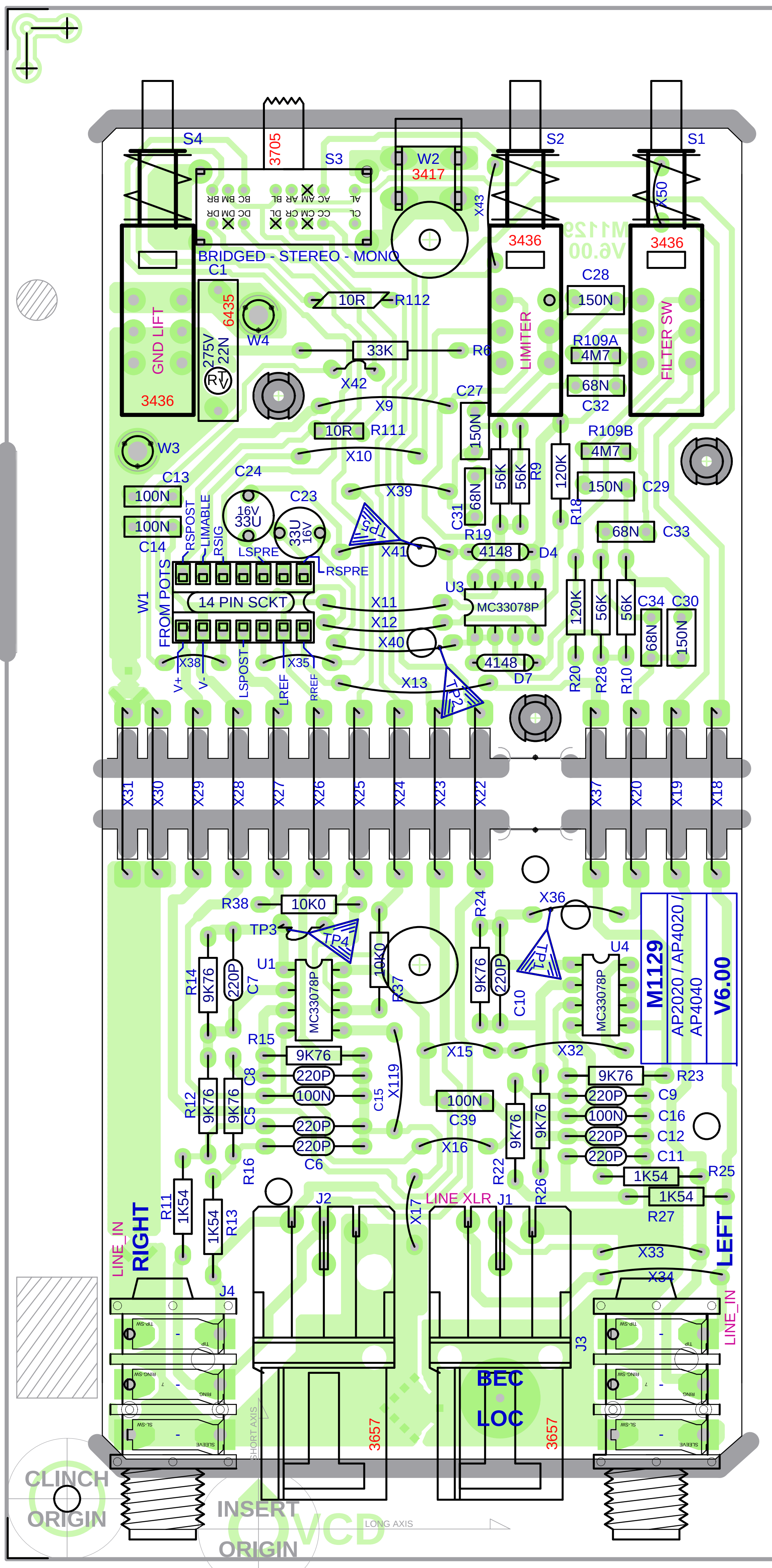
Yorkville

Product {Drawing Number}

{Title} | PCB# M1129 | Sheet 1 of 2

Date: Tue May 02, 2006 | Rev:v6.00

Filename: M1129-6v00.sch2002



S4
3705
S3
W2
3417
S2
S1
X50
X43
3436
BRIDGED - STEREO - MONO
C1
GND LIFT
6435
275V
22N
W4
10R
R112
33K
R6
X42
LIMITER
C28
150N
R109A
4M7
68N
C32
FILTER SW
C27
X9
10R
R111
150N
R109B
X10
W3
C13
100N
C24
C23
X39
56K
R9
120K
150N
C29
100N
C14
16V
33U
R18
68N
C31
R19
68N
C33
RSPOST
LIMABLE
RSIG
LSPRE
TP5
X41
4148
D4
RSPRE
U3
W1
FROM POTS
14 PIN SCKT
X11
X12
X40
MC33078P
C34
C30
X38
X35
4148
D7
R20
R28
R10
V+
V-
LSPOST
LREF
RREF
X13
TP2
X31
X30
X29
X28
X27
X26
X25
X24
X23
X22
X37
X20
X19
X18
R38
10K0
R24
X36
TP3
TP4
10K0
R37
U1
R14
9K76
220P
C7
MC33078P
TP1
U4
C10
M1129
AP2020 / AP4040
V6.00
R15
9K76
220P
100N
C8
C5
R12
X119
C15
X15
X32
R23
C9
C16
C12
C11
100N
C39
X16
R22
R26
R16
1K54
R25
R27
R11
R13
J2
LINE XLR
J1
X17
LINE_IN
RIGHT
LEFT
X33
X34
J4
J3
BEC
LOC
3657
SHORT AXIS
LONG AXIS
CLINCH
ORIGIN
INSERT
ORIGIN

M1129.sch_schematic-DATABASE_HISTORY			
MODEL(S):-	AP4020 / AP4040 / AP2020 / AM1CE		
#	DATE	VER#	DESCRIPTION OF CHANGE
1	OCT/1997	1.00	FIRST PRODUCTION
2	NOV/12/97	2.00	REVERSED INPUT POLARITY. MODIFIED FOR AP2020
3	DEC/02/97	.	C27, C28, C29, C30 TO 150n
4	APR/22/98	2.10	PC#5694 ADD NETS BRPRTCT, LVGND-28 TO BRG SW
5	SEP/06/01	2.20	DELETE R119
6	JUL/2005	3.00	CONVERT TO PCAD2002
7	D	V	N
8	D	V	N
9	D	V	N
10	D	V	N
11	D	V	N
12	D	V	N
13	D	V	N

M1129 DRILL HISTORY			
MODEL(S):-	AP2020/AP4020/AP4040/AM1CE		
#	DATE	VER#	DESCRIPTION OF CHANGE
1	APR-03-2003	V06	N
2	AUG-15-2005	V07	CONVERT TO PCAD2002
3	D	V	N
4	D	V	N
5	D	V	N
6	D	V	N

M1129 Database History			
MODEL(S):-	AP2020 AP4020 AP4040 AM1CE		
#	DATE	VER#	DESCRIPTION OF CHANGE
1	OCT/97	1.00	FIRST PRODUCTION
2	NOV/97	2.00	SWITCH NETS RREF WITH LREF AND RSPRE WITH
3	.	.	LSPRE AT 14 PIN CONNECTOR. INPUT TO NONINVERTING
4	DEC/02/97	.	CHANGE C27, C29, C28, C30 TO 150N
5	APR/16/98	3.00	PC#5694 PINS 10-12 OF MC2 CONNECTED TO BRG SWT
6	JUL/01/98	4.00	ISOLATE PIN OF S3
7	SEP/06/01	4.10	PC#6436 REPLACE R119 (10K0) WITH JUMPER X119
8	APR/15/05	5.00	PC#6873 REDO SOLDERMASK
9	JUL/2005	6.00	CONVERT TO PCAD2002, PC#6944:ROUTE GAUGE,
10	AUG-15-2005	.	PC#6914:ADD TARGETS
11	D	V	N
12	D	V	N
13	D	V	N

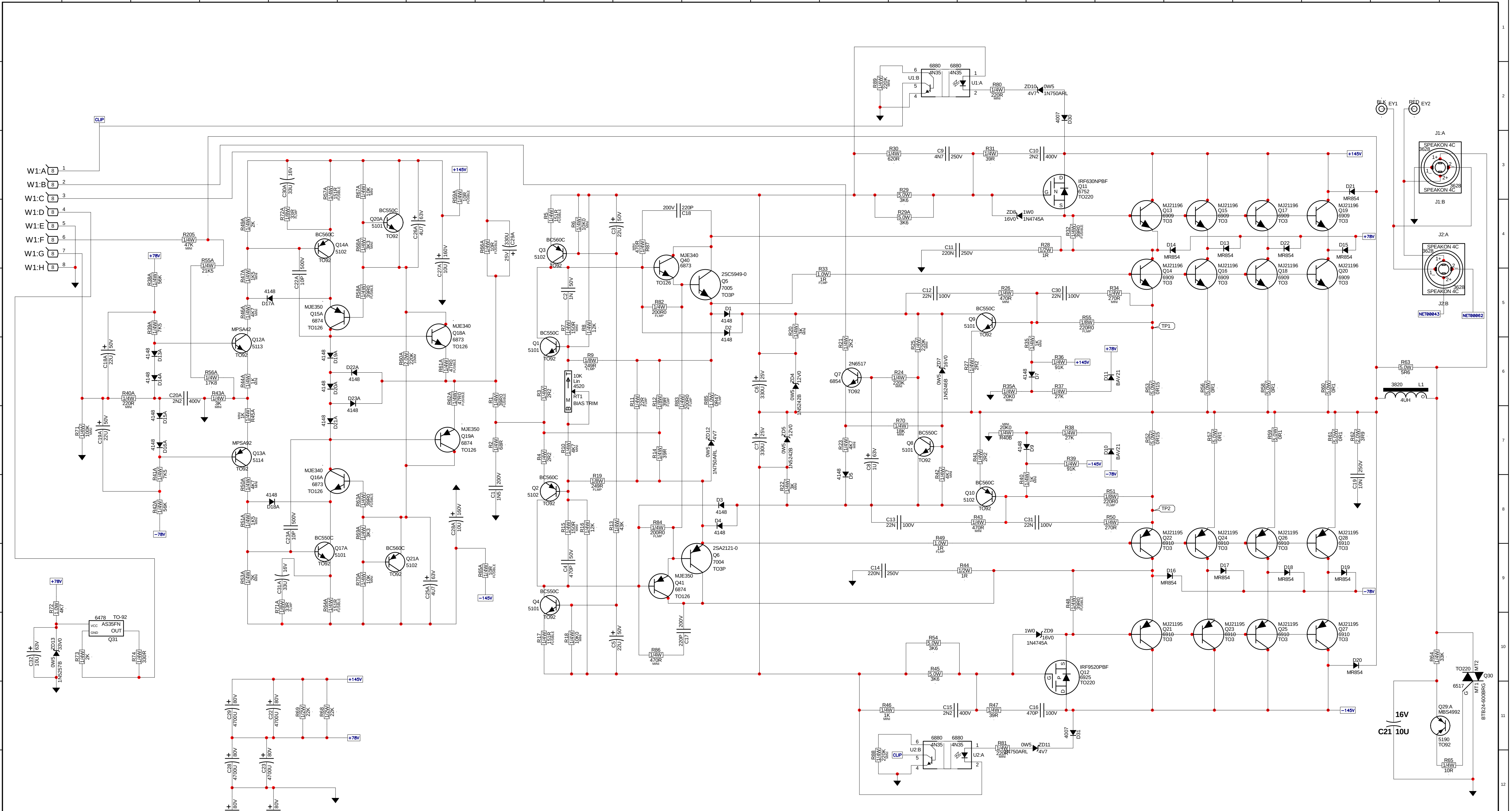
M1129 PENDING CHANGES		
MODEL(S):-	AP2020/AP4020/AP4040/AM1CE	
#	PC#	PENDING CHANGE
1	PC	X
2	PC	X
3	PC	X
4	PC	X
5	PC	X
6	PC	X

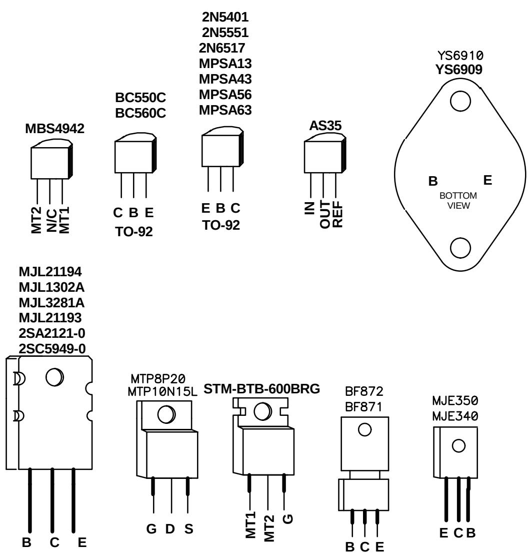
*PLACE IMPLEMENTED CHANGES INTO BOARD HISTORY

M1129 PRODUCTION NOTES

1 FOR XLR #3657 USE SCREW PT#8829
UP THROUGH THE BOTTOM

2 FOR M1129B VX1200/2400/J/2402
DO NOT STUFF X40 AND X41
ADD WIRES IN BOARD ASSEMBLY





M1146 Database History

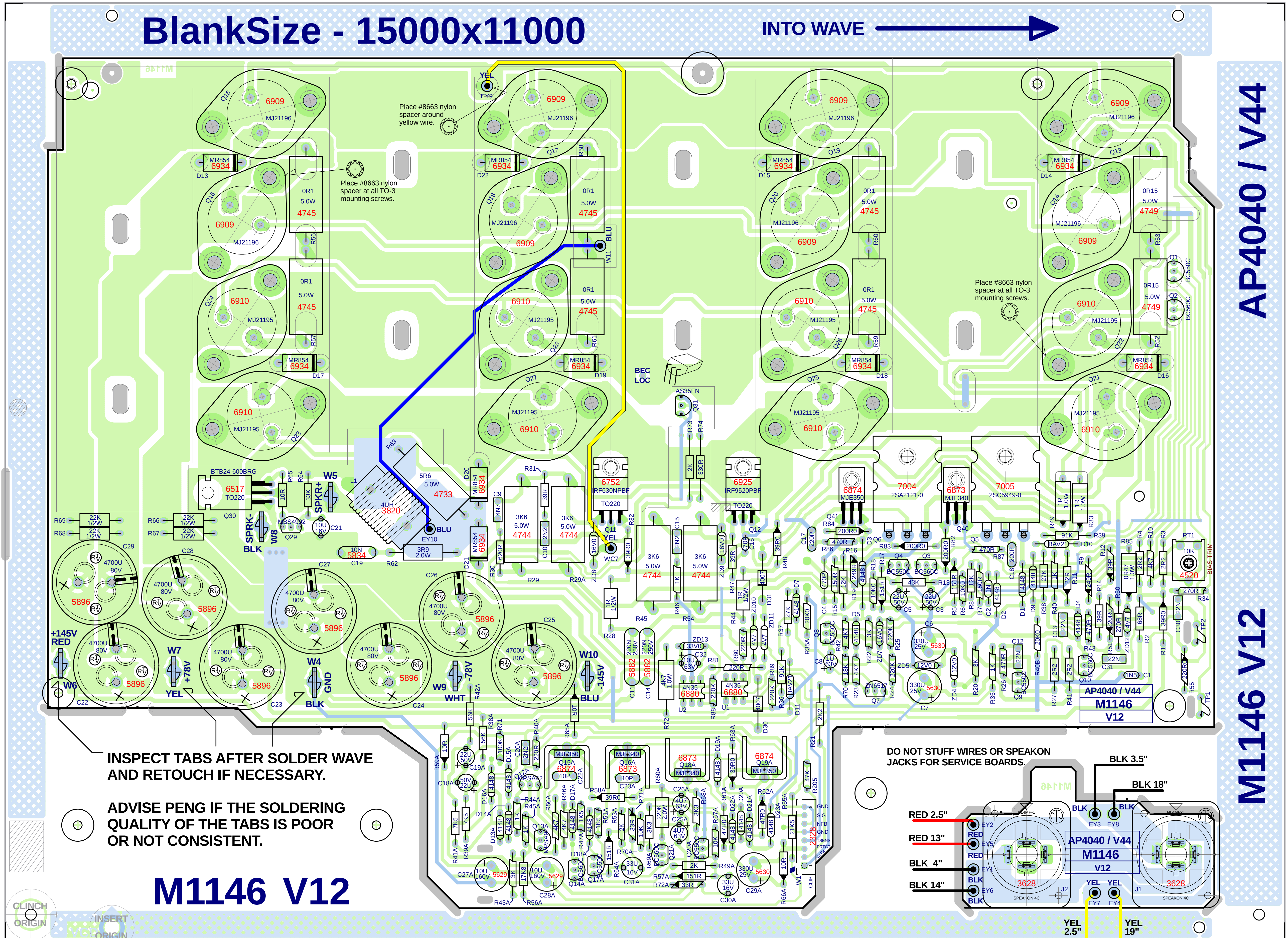
MODEL(S):- AP4040

#	DATE	VER#	DESCRIPTION OF CHANGE
1	FEB/12/98	1.00	DERIVED FROM M1126
2	JUN/19/98	1.10	PC#5767 C10,C15,C20A 2N2 TO PT#5427
3	JUL/4/98	1.20	PC#5798 R72 4K7 1/2W TO 4K7 1W
4	SEP/10/98	2.00	PC#5806 ADD 33R, 33u/16V ACROSS R57A,R64A,C30A,
5	.	.	-R72A,C31A,R71A
6	JAN/27/99	3.00	PC#5908 U1,U2 4N35 TO TLP621
7	JUL/08/99	4.00	SPKON JACKS RE-CONFIGURED
8	AUG/12/99	5.00	CORRECT ERROR IN SPKONS
9	OCT/12/00	6.00	PC#6278 ADD R86,C17 AT Q41. PC#6083 REDO GND TRA
10	AUG/28/01	7.00	PC#6429 ADD R87,C18 AT Q40
11	SEP/18/01	8.00	PC#6438 ADD R88,R89 AT U1, U2
12	MAY/03/02	8.10	PC#6517 Q13->20 #6900->#6909. Q21-Q28 #6927->#6910
13	.	.	R13 27K-<43K,C18 1N->220P,R87 100R->470R
1	MAY/16/03	8.20	PC#6607 C10,C15, C20A #5427->#5208
2	FEB/09/04	8.30	PC#6658 CHANGE BREAKAWAY AND ROUTE
3	SEP/2004	9.00	CONVERT TO PCAD2002
4	APR/25/06	9.10	PC#7007 MAC-224-4 TO STM-BTB-600BRG
5	MAY/02/06	9.20	PC#7083 MTP10N15L TO IRF630NPBF
6	APR/03/07	9.30	HA, PC#7076, REPLACE Q5 #6989 WITH #7004
7	.	.	Q6 #6990 WITH #7005
8	NOV/18/08	10.00	Solder Updates
9	10-SEP-2010	V11	Replace ribbon with XH conn GG
10	19-JUL-2012	V12	PC8460 - Changed to Double Sided PCB. - ML
11	D	V	N
12	D	V	N
13	D	V	N

Yorkville

Product **POWER AMP**

AP4040	PCB# M1146	Sheet 1 of 2
Date: Thu Jul 19, 2012	Rev: V12	
Filename: M1146V12SCH.sch2006		

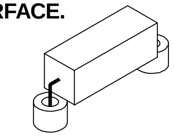


M1146 V12 ↓ SEE LAYOUT DOCUMENTATION ↓ AP4040 / V44

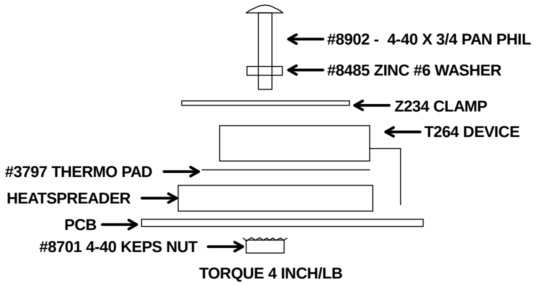
SEE LAYOUT DIAGRAM

M1146 PRODUCTION NOTES

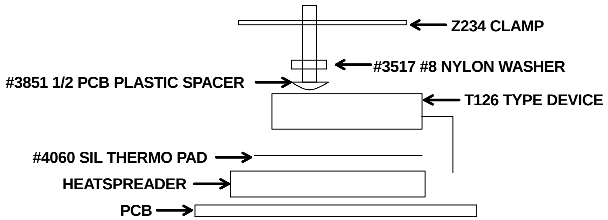
1. MOUNTING DETAILS FOR 5W ADD #8629 SPACERS ONLY ON 5 WATT RESISTORS R29, R29A R45 AND R45A. ENSURE SPACERS ARE UNDER RESISTOR BODY ENOUGH TO RAISE IT OFF THE BOARD SURFACE.

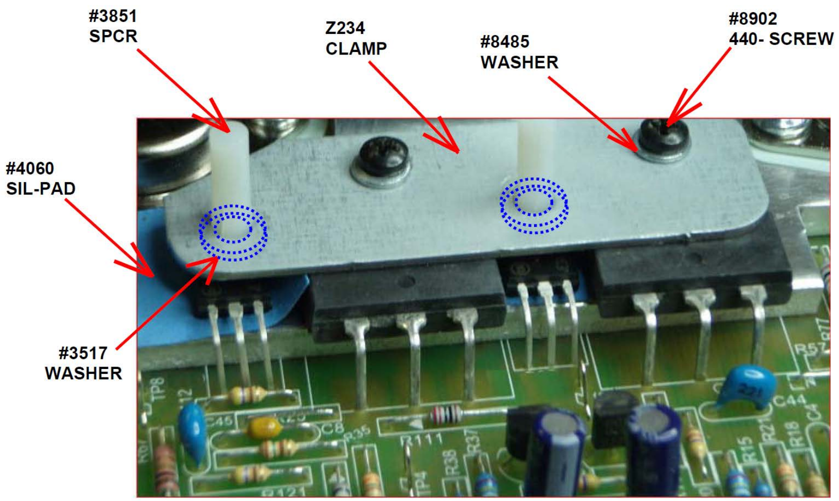


2. MOUNTING HARDWARE FOR Q5 AND Q6.



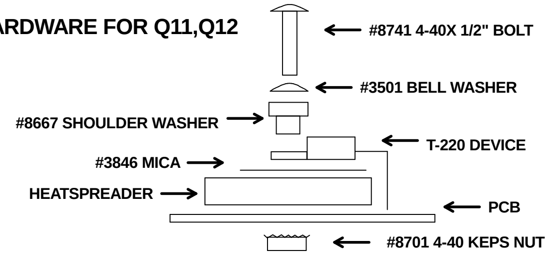
3. MOUNTING HARDWARE FOR Q40 AND Q41.



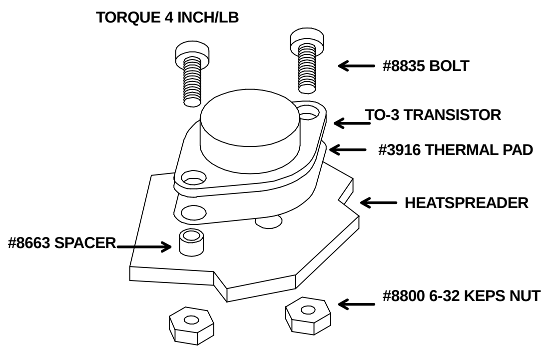


CLAMP DETAIL - SEE NOTES 2 AND 3.

4. MOUNTING HARDWARE FOR Q11,Q12



5. MOUNTING HARDWARE FOR TO3 OUTPUTS

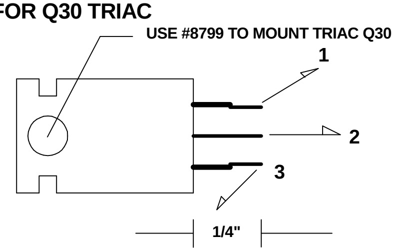


INITIAL TORQUE FOR TO-3'S IS 8 INCH/LB

FINAL TORQUE AFTER HEATSINK HAS COOLED FROM WAVE SOLDER IS 6 INCH/LB

6. USE #2006 SMALL BODY 1R 1W FOR R33 AND R49.

7. MOUNTING DETAILS FOR Q30 TRIAC

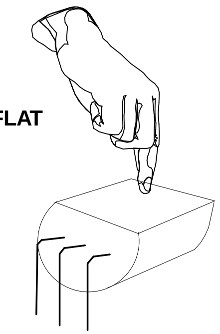


BEND DOWN 1/4" FROM BODY OF THE TRANSISTOR

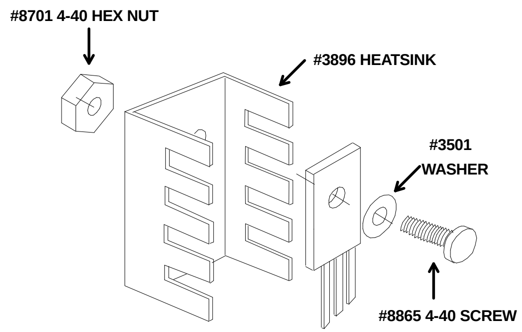
IMPORTANT: DO NOT CUT LEGS AFTER MOUNTING DEVICE. BEND LEGS AS PER DIRECTION OF THE BOTTOM PADS. IT IS IMPERATIVE THAT LEGS MARKED 2 AND 3 ARE BENT FLAT AGAINST THE BOTTOM COPPER SURFACE.

8. TAB WIRE COLOURS: TAB 1 RED 16AWG, TAB 2 YEL 16AWG, TAB 3 BLK 16AWG, TAB 4 WHT 16AWG, TAB 5 BLU 16AWG, TAB 6 OUTPUT +, TAB 7 OUTPUT -

9. Q31 IS HAND INSERTED AND BENT OVER WITH FLAT SIDE UP AS SHOWN.



10. MOUNTING HARDWARE FOR Q15A AND Q16A.



11. CHECK THE TRANSISTORS FOR ANY SHORT.

12. FOR CONNECTOR W1 USE YSPART 2328. TO PLACE THE CONNECTOR BEND RESISTOR R55A TO THE LEFT SO THAT THE CONNECTOR SITS FLUSH AGAINST THE BOARD.

13. INSPECT TABS AFTER SOLDER WAVE AND RETOUCH IF NECESSARY FOR A SOLID SOLDER JOINT. ADVISE PENG IF THE SOLDERING QUALITY OF THE TABS IS POOR OR NOT CONSISTENT.

SEE LAYOUT DIAGRAM

M1146 Database History

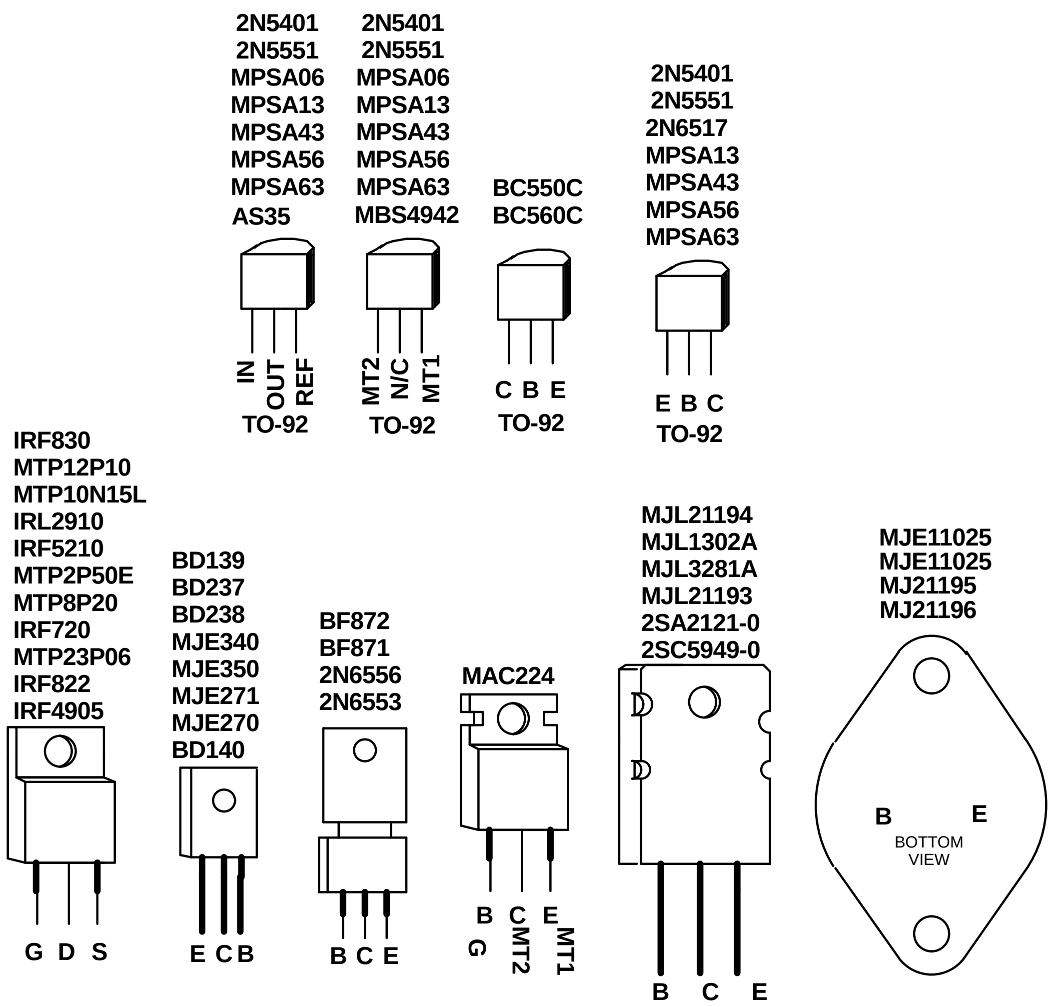
MODEL(S):- AP4040 / V44

#	DATE	VER#	DESCRIPTION OF CHANGE
1	FEB/12/98	1.00	DERIVED FROM M1126
2	JUN/19/98	1.10	PC#5767 C10,C15,C20A 2N2 TO PT#5427
3	JUL/4/98	1.20	PC#5798 R72 4K7 1/2W TO 4K7 1W
4	SEP/10/98	2.00	PC#5806 ADD 33R, 33u/16V ACROSS R57A,R64A,C30A,
5	.	.	-R72A,C31A,R71A
6	JAN/27/99	3.00	PC#5908 U1,U2 4N35 TO TLP621
7	JUL/08/99	4.00	SPKON JACKS RE-CONFIGURED
8	AUG/12/99	5.00	CORRECT ERROR IN SPKONS
9	OCT/12/00	6.00	PC#6278 ADD R86,C17 AT Q41. PC#6083 REDO GND TRA
10	AUG/28/01	7.00	PC#6429 ADD R87,C18 AT Q40
11	SEP/18/01	8.00	PC#6438 ADD R88,R89 AT U1, U2
12	MAY/03/02	8.10	PC#6517 Q13->20 #6900->#6909. Q21-Q28 #6927->#6910
13	.	.	R13 27K-<43K,C18 1N->220P,R87 100R->470R
1	MAY/16/03	8.20	PC#6607 C10,C15, C20A #5427->#5208
2	FEB/09/04	8.30	PC#6658 CHANGE BREAKAWAY AND ROUTE
3	SEP/2004	9.00	CONVERT TO PCAD2002
4	APR/25/06	9.10	PC#7007 MAC-224-4 TO STM-BTB-600BRG
5	MAY/02/06	9.20	PC#7083 MTP10N15L TO IRF630NPBF
6	APR/03/07	9.30	HA, PC#7076, REPLACE Q5 #6989 WITH #7004
7	.	.	Q6 #6990 WITH #7005
8	NOV/18/08	10.00	Solder Updates
9	10-SEP-2010	V11	Replace ribbon with XH conn GG
10	19-JUL-2012	V12	PC8460 - Changed to Double Sided PCB. - ML
11	D	V	N
12	D	V	N
13	D	V	N

M1146 Drilling History

MODEL(S):- AP4040 / V44

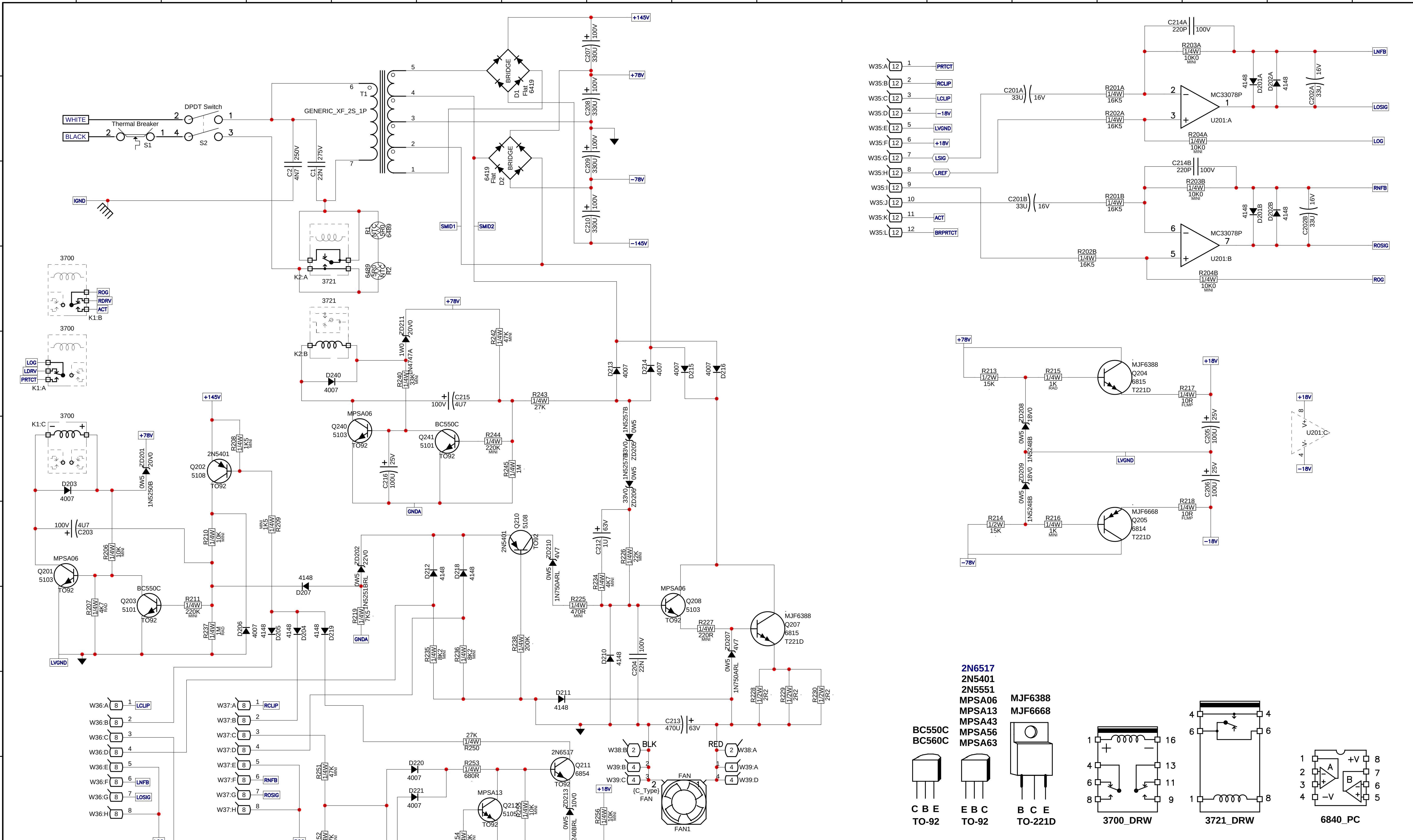
#	DATE	VER#	DESCRIPTION OF CHANGE
1	D	V	N
2	D	V	N
3	D	V	N
4	D	V	N
5	D	V	N
6	D	V	N
7	D	V	N
8	D	V	N
9	D	V	N
10	D	V	N
11	D	V	N
12	D	V	N
13	D	V	N



M1146.SCH_DATABASE_HISTORY

MODEL(S):- AP4040

#	DATE	VER#	DESCRIPTION OF CHANGE
1	APR/25/06	V	PC#7007 MAC-224-4 TO STM-BTB-600BRG
2	MAY/02/06	2.20	PC#7083 MTP10N15L TO IRF630NPBF
3	D	V	N
4	D	V	N
5	D	V	N
6	D	V	N
7	D	V	N
8	D	V	N
9	D	V	N
10	D	V	N
11	D	V	N
12	D	V	N
13	D	V	N

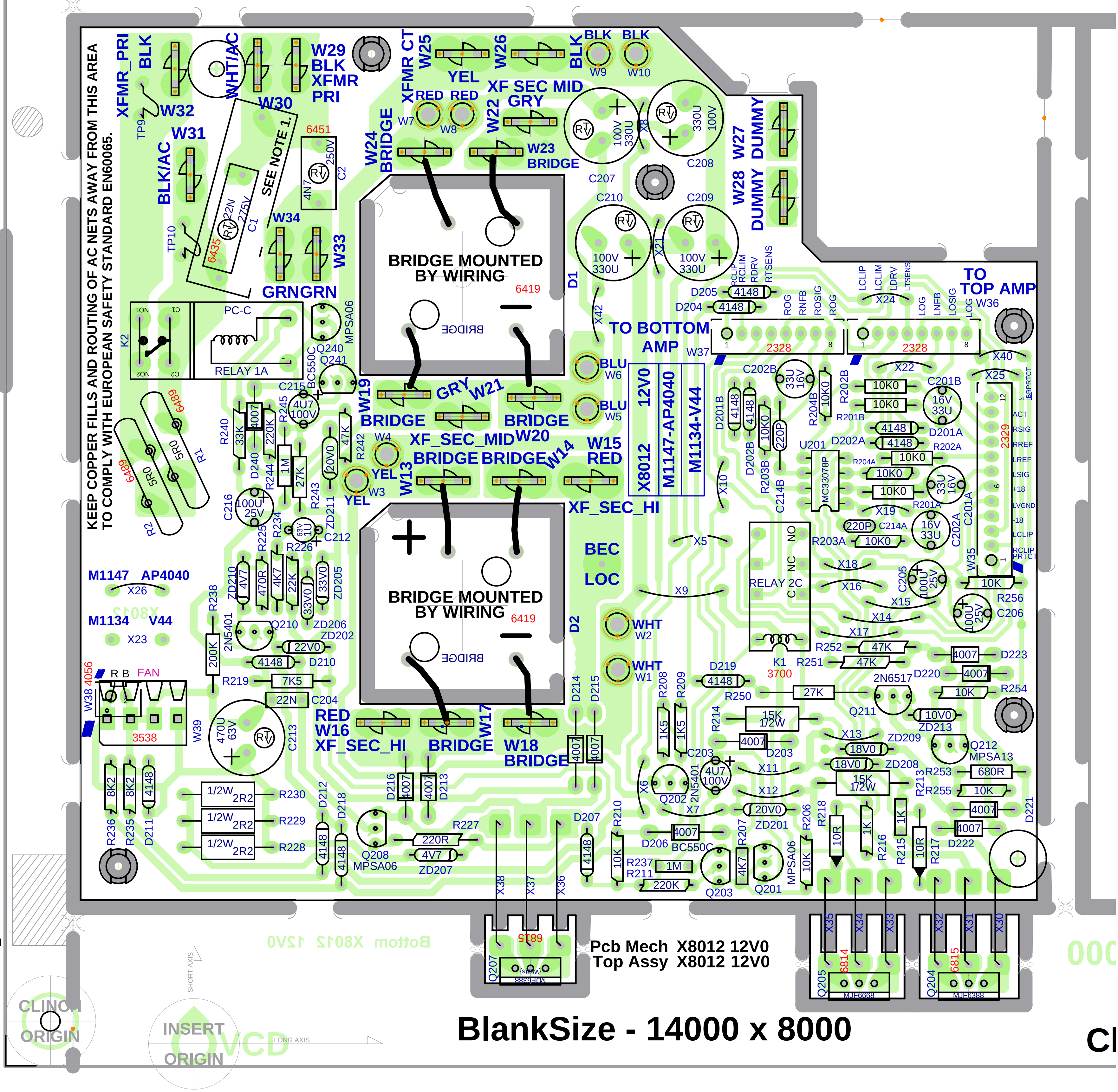


Yorkville

Product	AP4040/V44	
Sheet1	PCB# -	Sheet 1 of 1
Date: Wed Feb 03, 2010	Rev:12V00	YsType:YS
Filename: X8012V1200sch.sch2002		

StepAndRepeat - X2@6.675Y1@0.000

M1147 AP4040



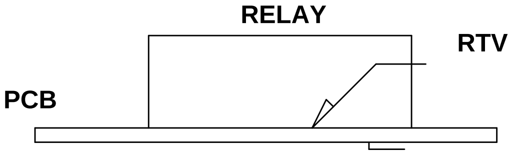
BlankSize - 14000 x 8000

SEE LAYOUT DOCUMENTATION

SEE LAYOUT DIAGRAM

X8012 PRODUCTION NOTES: M1147 AP4040

1. FOR C1 USE 22N FOR NORTH AMERICAN AND 680N FOR EURO.
2. ADD RTV UNDER RELAY AND BEND LEADS FLAT TO PCB.



SEE LAYOUT DIAGRAM

X8012 Database History

MODEL(S):- AP4040 AND V44

#	DATE	VER#	DESCRIPTION OF CHANGE
1	FEB/12/98	1.00	DERIVED FROM M1127
2	MAR/30/98	2.00	REPLACE R233&THERMISTOR WITH SURGISTORS
3	APR/07/98	.	PC#5664 ADD EXTRA PROTECT CIRCUIT
4	JUL/15/98	2.10	PC#5798 REPLACE ZD212 WITH JUMPER
5	OCT/27/99	3.00	PC#5695 ADD TP9,10 . ENLARGE AC TRACES
6	APR/03/00	4.00	PC#6218 UPDATE REL2 SYMBOL (HOLE LOCATIONS)
7	DEC/04/01	5.00	REPLACE JUMPERS FOR BRIDGE WITH TABS AND WIRES
8	JAN/15/02	6.00	NEW SOLDERMASK FOR TABS
9	SEP/2004	7.00	CONVERT TO PCAD2002
10	9-MAY-2006	8.00	REDO AC FOR CE COMPLIANCE
11	23 Nov, 2006	.	Imported test node locations from MD database.
12	08 Feb, 2007	9.00	CHANGED ROUTE FILE, FIX SPACING SNAPIN CLOSE W36
13	.	.	CHANGE C213 FROM 470U 25V #5618 TO 470U 63V #5621
1	23-JAN-2008	10.00	Solderability Update, corrected AC clearances.
2	17-FEB-2009	.	PC#7717,ONLY FOR V44. CHANGE R201A,R201B,R202A
3	.	.	R202B FROM 10K0 TO #5057 16K5 1% 1/4W
4	20-MAY-2009	11.00	CREATED X8012 FOR NEW CABLES, PC#7717 and 7738
5	OCT/21/09	12.00	PC#7885: Span change on X30-X35
6	03-FEB-2010	.	PC7935: Change C203, C215 from #5259 to #5269 GG
7	D	V	N
8	D	V	N
9	D	V	N
10	D	V	N
11	D	V	N
12	D	V	N
13	D	V	N

X8012 PCB_DATABASE_HISTORY

MODEL(S):- AP4040 AND V44

#	DATE	VER#	DESCRIPTION OF CHANGE
1	D	V	N
2	D	V	N
3	D	V	N
4	D	V	N
5	D	V	N
6	D	V	N
7	D	V	N
8	D	V	N
9	D	V	N
10	D	V	N
11	D	V	N
12	D	V	N
13	D	V	N

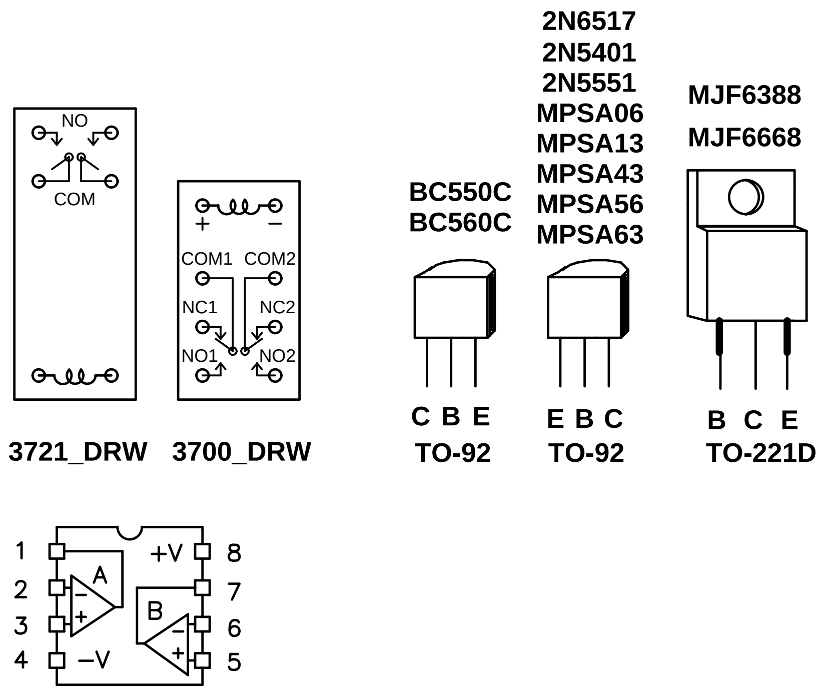
X8012 PENDING CHANGES

MODEL(S):- AP4040 AND V44

#	PC#	PENDING CHANGE
1	PC	X
2	PC	X
3	PC	X
4	PC	X
5	PC	X
6	PC	X

*PLACE IMPLEMENTED CHANGES INTO BOARD HISTORY

PIN CONFIGURATION



AP800 Parts List 8/15/2012

YS #	Description	Qty.
6478	AS35FN-TO92 TEMPERATURE SENSOR	2
5906	RED 3MM LED 1V9 20MA.4SPCER T&R	3
5908	GRN 3MM LED 1V9 20MA.4SPCER T&R	3
6419	BRIDGE 35A 400V WIRE LEAD GI3504	2
6425	BAV21 200V 0A25 DIODE T&R	4
6825	1N4148 75V 0A45 DIODE T&R	52
6438	1N4007 1000V 1A0 DIODE T&R	15
6934	MR854 400V 3A0 DIODE FASREC	20
6432	1N5248B 18V0 0W5 ZENER 5% T&R	2
6433	1N5257B 33V0 0W5 ZENER 5% T&R	4
6439	1N5225B 3V0 0W5 ZENER 5% T&R	2
6440	1N750ARL 4V7 0W5 ZENER 5% T&R	9
6450	1N5242B 12V0 0W5 ZENER 5% T&R	4
6461	1N5240BRL 10V0 0W5 ZENER 5% T&R	1
6463	1N5251BRL 22V0 0W5 ZENER 5% T&R	1
6465	1N5250B 20V0 0W5 ZENER 5% T&R	1
6824	1N5246B 16V0 0W5 ZENER 5% T&R	2
6429	1N4747A 20V0 1W0 ZENER 5% T&R	1
6822	1N4745A 16V0 1W0 ZENER 5% T&R	4
5101	BC550C TO92 NPN TRAN T&R TB	14
5102	BC560C TO92 PNP TRAN T&R TB	14
5103	MPSA06 TO92 NPN TRAN T&R TA	3
5108	2N5401 TO92 PNP TRAN T&R TA	2
5113	MPSA42 TO92 NPN TRAN T&R TA	2
5114	MPSA92 TO92 PNP TRAN T&R TA	2
6854	2N6517 TO92 NPN TRAN TA	3
5105	MPSA13 TO92 NPN DARL T&R TA	2
5106	MPSA63 TO92 PNP DARL T&R TA	1
6814	MJF6668 T221D PNP TRAN DARL TJ	1
6815	MJF6388 T221D NPN TRAN DARL TJ	2
6873	MJE340 TO126 NPN TRAN TG	6
6874	MJE350 TO126 PNP TRAN TG	6
6752	MTP10N15L TO220 NCH MFET TN	2
6925	IRF9520PBF TO220 PCH MFET TN	2
6909	MJ21196 TO3 NPN TRAN TH	16
7004	2SA2121-0 TO3P PNP TRAN TK	2
7005	2SC5949-0 TO3 NPN TRANSISTOR TK	2
6910	MJ21195 TO3 PNP TRAN TH	16
6840	MC33078P IC DUAL OP AMP	5
6745	LM13600N IC XCONDUCTANCE AMP	2
5190	MBS4992 TO92 8V5 DIAC T&R	2
6517	BTB24-600 TO220AB 25A TRIAC 600V	2
6880	4N35 OPTO-COUPLER	4
6489	__5R 20% THERM-SURGR NTC KNK LEADS	2
5401	_10P 500V 5%CAP T&R RAD CER.2NPO	4
5203	_47P 100V 2%CAP T&R RAD CER.2NPO	2
5410	100P 100V 10%CAP T&R BEAD NPO	2
5197	220P 100V 2%CAP T&R RAD CER.2NPO	1
5277	220P 200V 5%CAP T&R RAD CER.2NPO	4
5412	220P 100V 10%CAP T&R BEAD NPO	13
5201	470P 100V 5%CAP T&R RAD CER.2NPO	2
5416	470P 50V 10%CAP T&R BEAD NPO	2
5422	__1N 50V 10%CAP T&R BEAD NPO	2
5273	__1N5 200V 5%CAP T&R RAD CER.2NPO	2
5208	__2N2 400V 5%CAP T&R RAD .2FLM	6
5209	__4N7 250V 5%CAP T&R RAD .2FLM	2
6451	__4N7 250V 20%CAP BLK 'Y' 10MM AC	1
5834	_10N 400V 10%CAP BLK RAD POLY FLM	2
5210	_22N 100V 10%CAP T&R RAD .2FLM	9
6435	_22N 275V 20%CAP BLK 'X2' 15MM AC	2
5226	_68N 100V 5%CAP T&R RAD .2FLM	4
5212	100N 63V 5%CAP T&R RAD .2FLM	4
5228	100N 100V 5%CAP T&R RAD .2FLM	3
5314	100N 50V 10%CAP T&R BEAD X7R	2
5229	150N 63V 10%CAP T&R RAD .2FLM	4
5231	220N 63V 5%CAP T&R RAD .2FLM	2
5882	220N 250VDC 10%CAP BLK RAD PLY FLM	4
5234	470N 63V 10%CAP T&R RAD .2FLM	4
5255	__1U 63V 20%CAP T&R RAD .2EL	3
5258	__4U7 63V 20%CAP T&R 8X7MM .2EL	2
5259	__4U7 63V 20%CAP T&R RAD .2	4
5269	__4U7 100V 20%CAP T&R RAD LESR2	2
5282	_10U 16V 20%CAP T&R 5X7MM .2NP	2
5629	_10U 160V 20%CAP BLK 10X13MM EL	4
5945	_10U 63V 20%CAP T&R RAD .2EL	2
5260	_22U 50V 20%CAP T&R RAD .2EL	8
5961	_33U 16V 20%CAP T&R RAD .2IN NP	12
5267	100U 25V 20%CAP T&R RAD .2EL	3
5619	330U 100V 20%CAP BLK 12X25MM EL	4
5630	330U 25V 20%CAP BLK 10X13MM EL	6
5621	470U 63V 20%CAP BLK 12X25MM EL	1
5896	4700U 80V 20%CAP BLK 25X50MM ELS	16
4390	_10K AUD 16MM DETENT P22	2
4520	_10K TRIM POT	2
2448	15.00 AMP CIRCUIT BREAKER	1
3820	___4UH COIL 14AWG ZOBEL HORIZONTAL	2
3485	CLIP 250X032 18-22AWG RIGHT ANGL	4
3486	CLIP 250X032 22-18AWG DISCO-LOK	14
3489	CLIP 250X032 18-22AWG DISCO/INSL	2
3490	CLIP 250X032 14-16AWG DISCO/INSL	4
3601	RING TERMINAL 16AWG WIRE & #8 SCREW	2
3618	STAR RING TERMINAL14-16AWG #10SCREW	4
3410	RED:LEFT/BLACK:RIGHT BIND POST TPP5	1
3415	RED:RIGHT/BLACK:LEFT BIND POST TPP5	1
3918	1/4" JCK PCB MT HORZ SLIM W/SCREW	2
3628	SPKON 4C PCB MT VERT 250TAB GRY #4	2
3922	XLR FEML PCB MT HORZ THIN SNAP-IN	2
3451	EYELET SMALL 0.089 OD PLATED	12
9198	FAN 80MM X 80MM 40CFM 12VDC	1
7584	SQUARE-CUT O RING FOR AP AIR FILTER	1
8432	AP SERIES AIR GRILL BLACK PLASTIC	1
8434	AP SERIES PLASTIC HANDLE PAIR	1
3894	HEATSINK TO-220 W/TAB BLACK ANODIZE	8
3501	B52200F006 COMP WASH #4 SMALL	23
3803	NYLON SECUR-A-TACH MINI PLASTIC TIE	1
3810	4" NYLON CABLE TIE	12
3827	SQUARE BUMPER BUTTON BLACK	11
3852	STICK ON CABLE WRAP ANCHOR	1
8433	KNOB AP SERIES PLASTIC	2
8661	KNOB BUTTON FLAT GREY	3
8437	FAN FILTER LABEL	1
3468	8' 3/16 SJT AC LINE CORD STRIP 17"	1
3821	STRAIN RELIEF HEYCO #1200	1
8261	GE VELVET/MATTE LEXAN .007"X12"X24"	0.348
8701	4-40 KEPS NUT ZINC	20
8793	4-40 HEX NUT ZINC	3
8760	6-32 KEPS NUT TIN PLATED	64
8800	6-32 KEPS NUT ZINC	5
8854	6-32 X 1/4" O.D. HEX NUT ZINC CLEAR	4
8720	#8 SPRING NUT	2
8797	5/16-18 KEPS NUT JS500	1
3797	TO-247 THERMO CONDUCTIVE PAD	4
3846	TO220 THERMO PAD LARGE HOLE 56359B	8
3916	TO3 SIL-PAD REPLACES MICA	32
4124	SILPAD 1500ST 1.100 X0.820 BERQUIST	4
8432P	LOGO HOT STAMPED ON PLASTIC GRILL	1
4597	22AWG STRAN TC WIR JMP	23
4599	22AWG SOLID SC WIR T&R JMP	62
5299	24AWG SOLID SC WIR RAD JMP	8
4745	5.0W 0R1 5% BLK RES	12
4749	5.0W 0R15 5% BLK RES	4
2005	1.0W 0R47 5%FLAME PROOF T&R RES	2
2006	1.0W 1R 5%FLAME PROOF T&R RES	4
4677	1/2W 1R 5% T&R RES	4
4688	1/2W 2R2 5% T&R RES	3
4911	1/4W 2R2 5% T&R RES	8
4748	2.0W 3R9 5% T&R	2
4733	5.0W 5R6 5% BLK RES	2
2009	1/4W 10R 2%FLAME PROOF T&R RES	2
2037	1/4W 10R FUSIBLE T&R RES	6
4605	1/8W 10R 5% T&R RES	1
4875	1/4W 10R 5% T&R RES	2
4930	1/4W 10R 5% .2"U T&R RES	1
2039	1/4W 22R0 FUSIBLE T&R RES	2
2014	1/6W 33R 2%FLAME PROOF T&R RES	4
2016	1/6W 39R 2%FLAME PROOF T&R RES	2
2041	1/4W 39R0 FUSIBLE T&R RES	10
4899	1/4W 39R 5% T&R RES	6
2042	1/4W 47R0 FUSIBLE T&R RES	4
4811	1/4W 68R 5% T&R RES	2
4984	1/4W 150R 5%MINI T&R RES	4
2045	1/4W 150R FUSIBLE T&R RES	8
2021	1/4W 200R0 1%FLAME PROOF T&R RES	6
2023	1/6W 220R0 1%FLAME PROOF T&R RES	4
4857	1/4W 220R 5% T&R RES	2
4977	1/4W 220R 5%MINI T&R RES	7
2024	1/6W 249R 2%FLAME PROOF T&R RES	12
4867	1/4W 270R 5% T&R RES	2
4986	1/4W 270R 5%MINI T&R RES	2
4855	1/4W 330R 5% T&R RES	2
4821	1/4W 470R 5% T&R RES	2
4980	1/4W 470R 5%MINI T&R RES	9
4891	1/4W 620R 5% T&R RES	2
5019	1/4W 620R 5%MINI T&R RES	2
4873	1/4W 680R 5% T&R RES	1
4934	1/4W 1K 5% .2"U T&R RES	1
4981	1/4W 1K 5%MINI T&R RES	15
4854	1/4W 1K2 5% T&R RES	1
4988	1/4W 1K5 5%MINI T&R RES	6
4791	1/4W 1K54 1% T&T RES	4
4808	1/4W 2K 5% T&R RES	4
6113	1/4W 2K 5%MINI T&R RES	2
4847	1/4W 2K2 5% T&R RES	2
6124	1/4W 3K 5%MINI T&R RES	6
4826	1/4W 3K3 5% T&R RES	2
6136	1/4W 3K3 5%MINI T&R RES	2
4744	5.0W 3K6 5% BLK RES	8
4681	1.0W 4K7 5% T&R RES	2
4943	1/4W 4K7 5% .2"U T&R RES	1
4982	1/4W 4K7 5%MINI T&R RES	17
4887	1/4W 7K5 5% T&R RES	5
4990	1/4W 8K2 5%MINI T&R RES	2
4762	1/4W 9K760 0.1% *** T&R RES	8
4800	1/4W 10K0 1% T&R RES	2
4829	1/4W 10K 5% T&R RES	2
4983	1/4W 10K 5%MINI T&R RES	9
6116	1/4W 10K0 1%MINI MF T&R RES	12
4856	1/4W 12K 5% T&R RES	4
5008	1/4W 14K7 1% T&R RES	2
4630	1/2W 15K 5% T&R RES	2
4830	1/4W 15K 5% T&R RES	12
4771	1/4W 17K8 1% T&R RES	2
6125	1/4W 18K 5%MINI T&R RES	2
6123	1/4W 20K0 1%MINI MF T&R RES	4
4777	1/4W 21K5 1% T&R RES	2
4632	1/2W 22K 5% T&R RES	8
6118	1/4W 22K 5%MINI T&R RES	1
4833	1/4W 27K 5% T&R RES	6
4840	1/4W 33K 5% T&R RES	3
6122	1/4W 33K 5%MINI T&R RES	1
4878	1/4W 43K 5% T&R RES	2
6119	1/4W 47K 5%MINI T&R RES	9
4835	1/4W 56K 5% T&R RES	8
6139	1/4W 62K 5%MINI T&R RES	2
5007	1/4W 78K7 1% T&R RES	2
4586	1/4W 82K 5%MINI T&R RES	2
4898	1/4W 91K 5% T&R RES	4
4838	1/4W 100K 5% T&R RES	2
6120	1/4W 100K 5%MINI T&R RES	2
4851	1/4W 120K 5% T&R RES	2
4886	1/4W 200K 5% T&R RES	1
4668	2.0W 220K 5%10MM BODY T&R RES	2
6126	1/4W 220K 5%MINI T&R RES	10
6127	1/4W 470K 5%MINI T&R RES	2
4844	1/4W 1M 5% T&R RES	1
4948	1/4W 1M 5% .2"U T&R RES	1
4951	1/4W 4M7 5% .2"U T&R RES	2
6132	1/4W 8M2 5%MINI T&R RES	2
4751	1/4W 22M 5% T&R RES	4
3604	21" 14C-28AWG DIP HDR CABLE .05"	1
3699	RELAY 1C 02AMP DC48 006MA PC-S	1
3735	RELAY 1A 16AMP DC48 011MA PC-C	1
8870	#4 X 1/4 PAN PH TYPE A ZINC	2
8729	#4 X 3/8 FLAT QUAD TYPE A JS500 BLK	4
9975	#4 X 1/2 PAN PHIL TYPE A B.O.& WAX	4
8799	#6 X 1/4 PAN PH TYPE B JS500	2
8865	4-40 X 5/16 PAN PH MS JS500	2
8742	4-40 X 3/8 PAN PH TAPTITE JS500	2
8861	4-40 X 3/8 PAN PH MS JS500	8
8741	4-40 X 1/2 PAN PH MS JS500	3
8871	4-40 X 5/8 PAN PH MS JS500	12
8902	4-40 X 3/4 PAN PHIL MS B/O & WAX	4
8832	6-32 X 1/4 PAN PH TAPTITE JS500	4
8801	6-32 X 3/8 PAN PH TAPTITE JS500	4
8829	6-32 X 3/8 FLAT PH TAPTITE BO#C HEA	24
8761	6-32 X 1/2 PAN PHIL MS ZINC CLEAR	64
8796	6-32 X 5/8 PAN PH TAPTITE ZINC	2
8830	6-32 X 7/8 PAN PH MS JS500	2
8999	8-32 X 5/8 PAN PH TAPTITE JS500	17
8719	8-32 X 3/4 FILLISTER PHIL MS JS500	2
8815	8-32 X 3/4 PAN PH TAPTITE JS500	5
8809	10-32 X 1/4 PAN PH TAPTITE JS500	5
8749	10-32 X 1/2 QDX PH TAPTITE JS500	13
8740	5/16-18 X 3 GRD 5 HEX BOLT JS500	1
8869	8-18 X 1/2 THRD CUTTING FOR PLASTIC	4
8731	10-16 X 5/8 TYPE B HEX W/SLOT JS500	12
3570	14 PIN SCKT CLOSED FRAME DIP ONLY	1
8663	11/64 NYLON SPACER (MICRO PLASTIC)	66
3751	SNAP IN 5/16 SPACER RICHCO	3
3743	SNAP ON 0.5" SPACER RICHCO	5
3851	1/2 PCB PLASTIC SPACER	4
3417	6-32 SCREW TERMINAL PC MNT SNAP-IN	1
8657	6-32 X 3/8" HEX SPACER ALUMINUM	2
8629	10-32 X 1/4 SPACER PHENOLIC	16
3859	1/2 PLASTIC HEX SPACER #4	2
3502	NYLON FLAT WASHER OD.158ID.110H.070	2
8667	SHOULDER WASHER SWS-229 LENGTH 1/8	4
3511	#6 FLAT WASHER NYLON	2
8485	#6 SPLIT WASHER ZINC	4
8818	3/4 OD X 3/8 ID X .080 THICK WASHER	2
3517	NYLON WASHER #8 0.062	4
8850	#10 INT TOOTH LOCKWASHER BO	4
8921	#3MM ID3.2MM OD7.0MM THICK 5MM	4
3705	4P3T SLID SW PCMT H	1
3436	DPDT PUSH SW PCMT H BREAK B4 MAKE	2
3587	DPDT ROKR SW QUIK 250"AC/PWR ON-OFF	1
CH1197	XFMR:AP4040	1